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T. FISHER UNWIN, LTD., LONDON



Silvanus P. Thompson

**SILVANUS
PHILLIPS THOMPSON**

D.Sc., LL.D., F.R.S.

HIS LIFE AND LETTERS

BY

JANE SMEAL THOMPSON

AND

HELEN G. THOMPSON, B.Sc.

WITH ILLUSTRATIONS

LONDON: T. FISHER UNWIN, LTD.

ADELPHI TERRACE

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P R E F A C E

MEASURED by years, the life of Silvanus Phillips Thompson was not a long one ; but each day and each year was full, and in that sense long. He was essentially a man of action. Passing away as he did while still at the height of his activities, no leisure had come to him to sift and sort his accumulated papers, and his biographers have had to deal with an immense mass of material relating to his work and to his hobbies, only a small fraction of which is presented here.

He was too busy a man to keep any autobiographical journal, or even brief daily diary, his " little blue notebooks " of the last fifteen years being the nearest approach to one. Nor was he after his marriage in 1881 a regular writer of letters, save to his wife on the exceptional occasions when she was not with him.

We wish to thank many of his friends whose letters are quoted, and Mr. John Hassall for permission to reproduce the caricatures of " Brother Magnetizer." We are most grateful for the kind way in which our request for the loan of his letters has been met by his friends. Of course we have to deplore that some of his correspondents either have not been able to find his letters or have not kept them, for some of the missing ones would have been the best revelation of the playful side of his nature so difficult to present, and which so endeared him to the circle of his family and his intimate friends. Again and again we have been conscious of the extreme difficulty for us, standing in such close relation to him as his wife and his daughter, to see the man in his true perspective.

As we endeavoured to portray him through his work, it seemed that, for the most part, the material was best adapted for arrangement according to subject rather than in strict chronological order : thus Chapter V covers work

achieving early distinction and continuing throughout his life, and Chapter XII deals with other work begun as early but reaching its maximum in the latter part of his life. By confining the more technical matter to a few chapters which can if desired be omitted, we have tried to represent the man's life in its fulness, without making it tedious to those lacking knowledge of science.

J. S. T.

H. G. T.

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SILVANUS PHILLIPS THOMPSON

HIS LIFE AND LETTERS

CHAPTER I

ANCESTRY, BIRTH, AND EARLY TRAINING

THE family of Thompson of Morland, Westmorland, to which Silvanus Phillips Thompson belonged, trace their ancestry to one Thomas Thompson, a yeoman farmer of Strickland in Westmorland, whose grandson, John Thompson of Barton in the same county, came and settled at Morland in the later years of the seventeenth century.

Of him it is recorded on his tombstone that he was a highly educated gentleman, "a great admirer and well versed in the politer sort of literature," and that in 1699 he kept a Grammar School at Morland. The house which he built there bears, carved over the doorway, the initials of himself and his wife, and the date 1722, and still belongs to one of his descendants. He died in 1736, and the Parish Register states that he was "an eminent, worthy, and ingenious schoolmaster."

He left one son, Thomas, whose three sons, about the middle of the century, became members of the Society of Friends, or Quakers, who were at that time a very numerous body in Westmorland. These young men all suffered the penalty of dismissal from their father's house, a fate not uncommon in those days of intolerance. However, at the father's death the eldest son, John, succeeded to the house and property at Morland, where he lived, and became a worthy minister of the Society of Friends.

The second son, Thomas, great-grandfather of Silvanus Phillips Thompson, settled at Appleby, where he started as a grocer and later became a highly respected banker in the town. Of him it was said that he was of a very pacific disposition, and if he heard quarrelling or profane language in the market-place, he would rush out and try to reconcile those who disagreed. He is remembered at Appleby as the rebuilder of a bridge, which, being swept away by a great flood in 1812, was reconstructed by him at his own expense. Carved on the bridge are his initials: T. T. 1813.

In the later years of his life he was almost ruined by a disastrous fire which burned down the bank. He behaved with the greatest generosity, especially to the poorer depositors.

The arms of the Thompsons, though not used by the early Quakers, were preserved in a sketch which came down to the grandson Silvanus Thompson of York. They were a stag's head cabossed, on a shield argent, wavy a crescent or. The crest was a dexter arm embowed with hand holding three ears of corn or. Motto: "Industriæ Munus."

When Silvanus P. Thompson was writing notes for the *Life of Lord Kelvin*, he records that in 1899 he received the following letter from him regarding the Thompson arms:

"It is interesting to find that you too have ears of corn, though with a different motto. No doubt your family with the 'p' and mine without are of common origin in the north-west of England and south-west of Scotland, I suppose. Our shield also has a stag's head on the lower part of it. It has three stars above the stag's head."

The family to which Sir William Thomson belonged had, as a matter of fact, dropped the "p" out of their name when they went to reside in Scotland, adopting the more common way of spelling the name in that country.

Thomas Thompson of Appleby left several sons and daughters. The youngest son, also Thomas, had begun his studies as a doctor, but had to abandon that career after the misfortune of the fire. He went to London, where he took up the study of pharmaceutical chemistry under

ANCESTRY, BIRTH, AND EARLY TRAINING 3

William Allen, a Quaker, then head of the famous firm of Allen & Hanbury. As he showed himself a young man of great scientific ability, he soon became acquainted with some of the men of science of those days. Among them were the Quaker brothers—Richard Phillips, physicist and intimate friend of Michael Faraday, and William Phillips, geologist and Fellow of the Linnean Society, both also Fellows of the Royal Society. They were of a Welsh family which came originally from Swansea, and had numerous branches. Thomas Thompson married their sister, Frances Phillips, and started a business as pharmaceutical and manufacturing chemist at Liverpool. This business still exists, and is being carried on by his great-grandson, Edwin Thompson.

A learned man, and much interested in antiquarian studies, Thomas Thompson, during his long life of eighty-six years (he died in 1861), made various collections, of coins, autographs, minerals, and old books, especially of those relating to the early history of chemistry. Some of these latter afterwards became part of the library of his grandson, Silvanus Phillips Thompson.

Frances Thompson shared the intellectual tastes and pursuits of her husband, and their home was occasionally visited by her brothers. She was very vivacious, bright, and clever, and was described once by the late John Bright as a "notable woman." They had a large family, many of whom inherited the Celtic quickness and strong sense of humour of their mother. The eldest son, George, succeeded to the family business; two others emigrated to Canada, where they founded families in the province of Ontario. The youngest son, Silvanus, chose the teaching profession as his vocation in life.

The antiquated regulations of the older Universities of Oxford and Cambridge made it impossible for a Quaker to benefit from them at that time, so Silvanus Thompson proceeded to London to finish his studies at University College, and worked at Mathematics under the father of William de Morgan.

He obtained a post as Master at the Friends' School for

boys at York in 1841, and in 1848 married Bridget Tatham, daughter of John Tatham of Settle.

The Tathams of Settle belonged to a family which, in the person of Richard de Tatham of the Parish of Tatham in Lancashire, was ennobled by the King for his services as leader of the archers at the Battle of Flodden. Their arms were a shield argent and azure with three martlets sable; and crest of a hand holding three arrows, with motto "Pro Deo, Pro Rege, Pro Patria."

At the time of the rise of the Quakers in the seventeenth century some of his descendants joined that body, and one, Marmaduke Tatham, the direct ancestor of the Tathams of Settle, was imprisoned in Lancaster Castle in 1660 during the persecutions which took place at the beginning of the reign of Charles II.

The first John Tatham who went to reside at Settle was the fourth in succession to Marmaduke, and was the grandfather of Bridget Thompson.

The second John Tatham conducted the old-established business of grocer, druggist, and draper in the Market Square of Settle, and built a house, known as Castle Hill House, under the shadow of the Castle Rock which dominates the little town. Here his family were born. His first wife was delicate, and only two of her children, Bridget and a sister, survived to maturity. He married a second time, and had other children; two sons grew up, but both died young. John Tatham was a very noted botanist in his day, and corresponded with botanists all over the kingdom. He discovered many rare plants and ferns, and was an ardent collector. His collections at a later date went to form part of the National Collection at Kew. His daughter Bridget shared his enthusiasm for botany, accompanied him on his rambles over the Pennines, and became a keen student and collector of plants. It was in connexion with this pursuit that she became acquainted with Silvanus Thompson. They were married at the old Friends' Meeting House at Settle, and went to live at York at a small house, 43, Union Terrace, adjoining the playing-fields of Bootham School to which they had access by a gate from their

back garden. Afterwards, when their family became numerous, they took the house next door, No. 45, and opened doors of communication between.

Silvanus Thompson was a quiet man, of gentle manner, intellectual tastes, and a religious disposition. As a teacher he was clear in presentation, and enriched his lessons with a wealth of historical illustration. In appearance he was tall and thin, and resembled his mother in colouring, inheriting also her strong sense of humour.

Bridget Thompson was *petite*, fair, and of delicate constitution, but full of energy and charm. Their eldest child, a son, William Henry, was born in 1849, and the second, Silvanus Phillips, on June 19th, 1851. Three other sons and three daughters followed, of whom one boy died in infancy. This little flock was most carefully reared and trained by the father and mother. Bridget Thompson had a wonderful gift in educating children. Long before the ideas of Froebel or Montessori had reached the educational world in this country, she trained her children in drawing, nature study, and handicraft, and taught them at a very early age to reproduce what they had seen.

The little Silvanus showed a scientific bent when very young, and began to draw when he was scarcely more than a baby. His mother used to tell many stories of his precocity, and treasured his early paintings and little objects made of wood or cardboard, which already showed the neatness and capacity for taking pains, which were of such service to him in his later scientific studies.

Silvanus was a very good-tempered and merry little child; he resembled his Celtic ancestors in the blue-grey eyes and black curly hair, but was slightly built and small like his mother. He was very thoughtful, and one day, while watching a baby sister on his mother's knee, he asked her, "Mother, are baby's brains hollow tubes for the instinct to flow through?" His sister Maria was most like him, and was always a favourite playfellow. She wrote in later years:

"I came next in age to Silvanus, and was eager to share his fun and mischief, and patiently endured when the

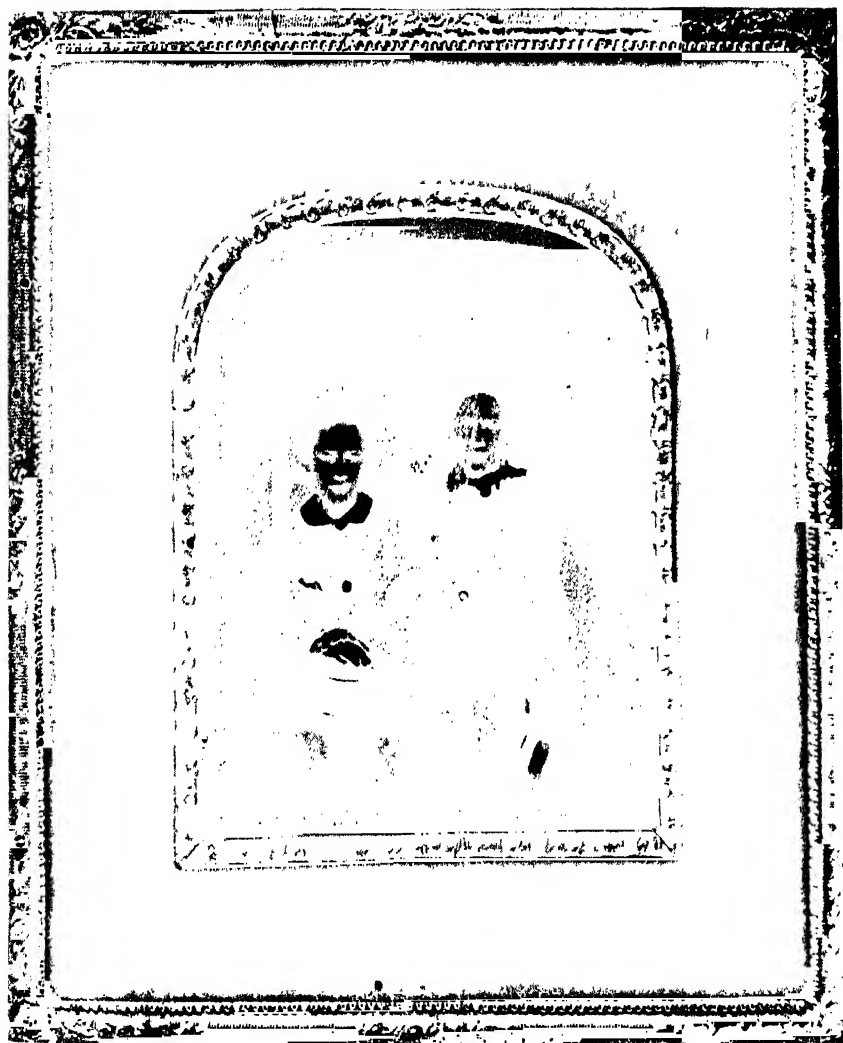
scientific experimentor had need of a victim. Silvanus would make wonderful cranes and lifts, and haul me up and down in them, and though they often broke, and bumps resulted, his active mind was always ready to plan a new and improved method. Once he had been reading in a book of travels, a description of how tattooing was done. When left alone in the nursery he borrowed nurse's darning needle and pricked into my wrist a star. Nurse returned to find him rubbing ashes from the grate into it. Forty years after, it could still be faintly seen."

Their father's duties at the school kept him very closely occupied, but he drew his children into pursuits which he enjoyed himself, the collection of coins and autographs, the study of heraldry, and the reading aloud of poetry and fine prose. They were brought up on Dickens, and often quoted his writings. When the grandfather died, in 1861, his collections of coins and autographs came to the family, and the older children much enjoyed them.

At the age of ten Silvanus coloured a drawing which he had designed himself, impaling the coats of arms of the Thompson and Tatham families, the only heraldic mistake he made being that he put the arms of his mother on the wrong side. This drawing was preserved by her, and is still in existence.

When the two elder boys were five and three years of age, they suffered from a severe attack of scarlet fever, which had bad effects on them both. The eldest was seriously retarded in development, and Silvanus was left with a delicate throat, which rendered him liable to attacks of laryngitis.

Often when ailing the children were sent to their grandfather's home at Settle, and sometimes also the school holidays were spent there. They grew up with a great love for the beautiful mountain scenery which surrounds the little town in the middle of Ribblesdale where their grandfather lived. They became familiar with crag and waterfall, and their interest in botany was stimulated by searching for the rare Tatham fern, or some other plant first discovered by their grandfather. They learned to take long tramps



SYLVANUS P. THOMASON STANDING BESIDE HIS ELDER BROTHER W. H. THOMASON
TAKEN IN 1875

over the moors and fells, and Silvanus all his life preferred this form of exercise to any other.

In August 1858 the two eldest boys were sufficiently advanced in their education to enter Bootham School as day boys, where they were placed in the lowest class. For four years Silvanus remained the youngest boy in the school, though it was not long before he was promoted to a higher class.

Bootham School, begun as a private enterprise and taken over by a committee of Yorkshire Quakers to provide a good education for the sons of their members, has, through the eminence of some of its old scholars and the ability of its headmasters, made a name for itself in the annals of those who are pioneers in education. In 1858 it was, however, quite a small school of about fifty boys, and though occupying its present site, was very different from the fine building which has since been erected.

John Ford, its first headmaster, was at that time still connected with it. He was an original and able educator. As in the present day, one of the great objects of the school was to give the boys a wide outlook on the world around them, and to teach them to make good use of their leisure, by the encouragement of all kinds of handicrafts and natural history hobbies. Careful training, too, was given for the attainment of that self-control which is the mark of the Quaker, and was a constant aim in the minds of the masters. John Ford did not at that time reside at the school, and the actual superintendence fell upon his second in command, Fielden Thorp, B.A.

The Head was a very enthusiastic advocate of the joys of natural history studies, and used to give half-yearly addresses to the boys on that subject. His Sunday evening discourses were very impressive, and certainly had a most powerful formative influence upon his hearers.

He and his wife were childless, and became very much attached to the clever children of his colleague Silvanus Thompson. Especially after his wife's death, John Ford almost adopted some of them, and the four little brothers often stayed with him in St. Mary's near the Abbey.

In an article entitled "A Scientist in the Bud" which appeared in the school magazine, James Edmund Clark, a former schoolfellow, gave an account of Silvanus as a schoolboy. He was fond of games, but not very proficient, and never reached the school cricket eleven; he was therefore not a hero with the boys. His lessons never gave him any trouble or seemed to present any difficulties. In class time he used to amuse himself with sketching in his notebooks. His productions were the envy of his class mates, who strove to outdo their impish ugliness in vain. In later years he still sketched in notebooks, and the record of many a scientific lecture or international committee was enriched by clever pencil drawings, sometimes by way of caricature, of people present. Silvanus very early became a contributor to the school magazine, one of his first essays being on "Electricity," a subject which was to absorb so much of his future life. He also gained a prize for a botanical collection made at the age of twelve.

The school was fortunate in having a very clever visiting art master, Mr. Edwin Moore, brother of the famous Henry Moore, R.A., and of Albert Moore. Silvanus profited much by his teaching, and continued his studies under him after school days were over.

In 1865, when he reached the senior class at the school, he took up the study of astronomy with great enthusiasm, and with J. E. Clark spent much time in the school observatory. "Probably his earliest printed scientific observations will be found in the 'Luminous Meteor Committee's' Report to the British Association, 1867."

At the age of sixteen he, with some of his schoolfellows, was taken to London to sit for the Matriculation of the University. The examination in those days was very comprehensive, including Greek, Latin, French, German, Chemistry, Hydrostatics, and Mechanics, besides English subjects. Fortunately for Silvanus, his splendid memory and the ease with which he learned languages carried him triumphantly through the ordeal.

They stayed with their master "in one of those quiet streets between the Strand and the River."

The following letter, on June 24th, 1867, written from Angus's Hotel, tells a little of the eager interest of the boy on his first visit to London.

"MY DEAR FATHER,

"Perhaps you will have curiosity to know why I am so long in London without telling you what has befallen me there, and perhaps more would have befallen me if I had been in London all Sunday: but to tell my story:

"Ye scene of ye action of ye Drama: The Great City.

"Act I: A walk to St. Paul's—magic effect.

"Scene I: Fleet Street; Scene II: The Strand, etc.

"Act II: Registration.

"Scene I: Burlington House—in waiting.

"Scene II: An Upper Room—Doctor Carpenter.

"Scene III, IV, etc.: St. James's Park, Horse Guards, Westminster.

"Scene VIII: Royal Academy (magical).

"Two happy hours among the works. An invitation to Croydon.

"Act III: The Country. Scene I: John Morland's, where J. E. C. and I stopped till eleven o'clock this morning.

"But the long and short of it is that both the Latin papers have been very easy, and we are much encouraged for the future. Both Jim and I finished the Grammar in an hour—only one-half the specified time. We are rather afraid of the Greek.

"Croydon is a very nice place and much spread out into the country. It is very hard to sleep here from the roar of the trains from Ludgate Hill to Blackfriars which wakes you up about every twenty minutes."

The letter was embellished with a drawing of one of the Latin examiners. "I got him before the papers were given out." Walks in the London parks, steamboat excursions on the Thames, and a visit to the Polytechnic to see "Pepper's Ghosts," were all a joy to the eager lad, who never forgot his first visit to London.

to betray a good conceit of himself. "I was introduced to John Bright by John Ford with the words: 'John Bright, allow me to introduce to thee a son of thy old friend Silvanus Thompson; the young man is a Bachelor of Arts of the University of London.' John Bright took in the situation, tipped his nose a little into the air, looked at me through his blue eyes, gave a sort of sniff, and this was all he had to say to congratulate me: 'Nature provides a very convenient safety-valve for knowledge too rapidly acquired!' Can you imagine a more complete dressing down for the young hopeful of nineteen?—no doubt immeasurably well deserved. But the crestfallen young man lived to thank John Bright for the good service he had done him in that somewhat brutal manner."

The following year, 1870, he went as junior master to Bootham School, where his father was still senior master; to avoid confusion, he was at that time always called Phillips, which the sisters and brothers shortened to Phil.

But the work of a junior master by no means satisfied the extraordinary intellectual energy of the student. He immediately took up the study of science, particularly chemistry, and at the end of three years succeeded in gaining the post of science master in the school. One of his colleagues, Alfred Kemp Brown, writes: "His lessons at York were admirable, illustrated with diagrams prepared with his special artistic talent." He taught chemistry, physics, and electricity, and much of the electric apparatus constructed by him was in use many years afterwards in the school laboratory.

Caring little for games, he was not very popular with the boys, except those who went in for making scientific collections, or shared his taste for art; these found him a tremendously stimulating companion. He continued to take lessons from Mr. Edwin Moore, and in a letter to a former school-fellow he wrote in 1873:

"The school seems to be going on pretty much as usual. A football match with Scarboro' to come off in about a fortnight is now all the talk. E. E. Boorne is now the only one learning oil-painting with me. R. Fox does a little at

fruit in watercolours. Joseph West, a younger brother of 'Tuffins,' learns painting with Moore. He is a clever little chap with his hands—draws animals beautifully."

The Joseph West here referred to is the well-known artist J. Walter West, R.W.S., who in later years painted a portrait of Silvanus P. Thompson in academic robes.

Besides his taste for painting, the young master was becoming very much interested in the study of music. Owing to the objection to that art which was still maintained in those days by many Quakers, the subject was not taught in any of their schools. At home the young Thompsons had no piano, and it was not until Silvanus rebelled against this prejudice that the opposition of the parents was gradually broken down. Brought up almost under the shadow of one of the most glorious cathedrals in England, and taught to understand and love its splendid architecture, it would have been strange if Silvanus had not also learnt to love the magnificent music of York Minster. He often attended Evensong, though his doing so was not looked upon with favour by the authorities of the school. As soon as he had saved up some money he bought a second-hand piano, and taught himself to read music and play accompaniments, though he never achieved any technical mastery over the instrument. He also learned to sing, and had a pleasant baritone voice which he produced well.

During these years the Temperance Question was much discussed and promoted among the Members of the Society of Friends in York, Joseph Rowntree being one of the prominent advocates of the movement.

Silvanus was attracted by the work of the Good Templars, and for a time his absorption in it was very great. He became a member, not only of the Local Lodge, but of the District Lodge, and later of the Grand Lodge. In 1873 he was doing much writing for them, and with his usual keenness to get at the beginnings of a movement or an invention, he studied very fully the whole history of the rise of the Good Templars in America, and collaborated in writing a book on it which was published in 1873.

Meantime, also, he was working for his B.Sc. degree of London University, the preliminary examination for which he passed while still teaching.

But the monotony of work in a small school, then badly equipped for teaching science, became very irksome to Thompson, and only the desire to be of assistance to his father kept him in this position. Silvanus Thompson senior was at that time suffering in health from the result of a railway accident in which his head had been injured, and it was with a great effort that he managed to continue his work until 1874, when he retired.

About this time the death of John Ford, who left most of his property to Silvanus and his wife, who had daily visited him in his declining years, and "been more than son and daughter to me," made financial matters rather easier for the family. The following year, too, John Tatham of Settle died at the age of eighty-three, leaving a widow and two daughters, Bridget Thompson, and Hannah Maria, who continued to live in the old family home with her stepmother.

In the long summer vacation of 1874 Silvanus junior went for his first visit to the Continent. During his journey he kept a journal letter for the benefit of his invalid father, which is full of delightful details of what he saw, and his many amusing experiences.

Starting on June 17th, he sailed from Hull to Antwerp, then journeyed via Brussels to Basle, visiting Luxembourg and Metz en route. From Basle he travelled mostly on foot through the Juras, carrying a knapsack and sketching materials. He found the Swiss German of the peasants in those days very difficult to understand, and several times was misdirected when inquiring his way from village to village. But his excellent French generally helped him along whenever that tongue was understood.

During his tour of nearly six weeks he made dozens of sketches, of which perhaps the most charming is one of the little walled town of Laufen, which he came to on first leaving Basle. He wrote from there:

"Altogether I enjoy the oddity of the place extremely.

It is now seven o'clock, and I am now going out for a walk in the fields (Isaac like) at even. I will and must make a sketch of this main street before departing. It is most wondrous."

While commenting on the strangeness of all around him, he writes :

"One thing seems utterly unchanged ; and that is human nature. I find people polite and attentive as a rule, when one is polite and pleasant to them. The French are of course superficially polite always. The politest person I have come across was the most hideously ugly Frenchman you can imagine, at the Luxembourg Station at Brussels. Except in these external things and in general national characteristics that I have not yet learned, I find that physiognomy is really a wonderfully true guide. A huge Prussian official at Mulhausen had a big kindly face, and on making some inquiries of him, I found him as gentle as a lamb and as polite and obliging as the most exquisite Parisian could be."

In this passage we see revealed the secret of the great success of Silvanus Thompson in his subsequent international relationships. A few weeks later the young traveller wrote, with a great glee, that he had been mistaken for a Frenchman.

His first view of the High Alps, where he was so often in later years accustomed to revel in the glory of glacier and snow peak, was obtained from the Weissenstein.

"Ah, what was that ? What is that sharp unearthly streak of light that shoots up clear above the clouds into the blue ? It is the Jungfrau—and now I see them—there they are, clear out above the white piles of cumulus—the Aletsch Horn, the Mönch, the Eiger—in fact the whole range of the Oberland—and then further to the South the peaks of some unknown heights, the sharp flat top of Monte Rosa, and then the Matterhorn. Going over the prospect again, I jotted down a hasty outline of the peaks. Then I took a final gaze upon those ethereal crests of unimaginable pearl,

and turned to descend. Do you ask me why I did not paint them? You might as well ask me why I do not paint the sun shining in all his brilliancy. Both are alike utterly unapproachable.

"Well, one of the dreams of my life has been at last fulfilled. The snow peaks of the Alps are stamped into my mind for ever. After this has been permitted, who can tell what other dreams may not have their realisation in the unknown hereafter?"

Returning to York refreshed, he plunged into his work of teaching, experimenting, studying, with a renewed zest, but at the end of the year he decided that he must leave the school and go to London for further help if he wished to take honours in chemistry, as he aspired to do, in his examination for the B.Sc. degree.

During several of his shorter holidays previous to this time, Silvanus had paid visits to some of his uncles and aunts on his father's side, who lived at Liverpool and Birkenhead. Here he found a delightful circle of cousins, rather older than himself, but many of them greatly interested in science, art, and music, who gladly welcomed him as a sharer in some of their lively reunions.

Two of them, William Phillips and Isaac C. Thompson, had with some other friends started a magazine entitled *Bachelor's Papers* for the discussion of scientific and other problems, and they persuaded Silvanus to contribute to this. It ran for a few months, and then apparently died out. His articles were entitled "The Sixth Sense," "The Progress of the Theory of Natural Selection," "Our National System of Weights and Measures" in two parts, "The Present Chaos" and "The Proposed Reform," "The Poems of Morris," "Religion and Science." He had then already in the early seventies achieved a certain distinction of literary style, and his arguments on scientific questions were put with great clarity and conciseness.

The end of the summer term 1875 saw the severance of his connexion with Bootham School, where he had spent so many years.

During the vacation he took the post of holiday tutor

to the sons of Richard Fry of Bristol, which brought him into touch with many influential Quakers in that part of the country, a circumstance which proved very useful about a year later.

On the result of his Intermediate Science Examination, Silvanus had gained a bursary at the Royal School of Mines, South Kensington. He therefore decided to take up Chemistry and Physics there, in preparation for his final examination. Owing, however, to some red-tape regulations about subjects of study with which he was unwilling to comply, he was not able to make full use of his bursary, so during his stay in London he had to exercise the most rigid economy.

In October he took rooms at 83, Robert Street, South Kensington, sharing his sitting-room with another Quaker student, Ernest Westlake of Southampton. He began work at once in the laboratories of the Royal School of Mines at South Kensington. The Professor of Chemistry at that time was Edward Frankland, F.R.S. (afterwards Sir Edward), and Thompson at once attracted his attention. The following letter describes his first impressions of the novel surroundings :

" Saturday afternoon,

" October 19th, 1875.

" MY DEAR FATHER,

" You will have wished, I don't doubt, to have heard a little more concerning my occupations than as yet I have written.

" Now that I am fairly settled to work, and with the extra work of my approaching Exam., it is difficult to find a time to write letters except late at night ; and then those cannot go until the next day.

" Westlake and I breakfast at 8 a.m. punctually. By half-past nine the laboratories are open, and so I go early three days a week.

" The other three days, Mondays, Wednesdays, and Fridays, it is not worth while to go early, as Frankland begins to lecture at 10, and it is too much trouble to get things out for half an hour or rather less, and then lock

them up while one goes down to the Lecture Room five stories below, down 103 steps. As soon as the lecture is over the Laboratory work begins. As yet I have been doing only simple analysis. . . . The more I see of the students the less I like most of them. I am a little older than the average, but many of them are quite oldish men (mostly the teachers in training). I go at one p.m. to Professor Guthrie's Lectures (six stories below) on Physics—at first on Hydrostatics and Pneumatics, but now just beginning Sound. He lectures every day except Saturday. He is a ponderous Scotchman, and puts in 'of course' about thirty times each Lecture. Frankland is a much neater and tidier lecturer. His experimental illustrations are all most excellent.

"I have quite given up the idea of University College at present. It is so far, and the lecture times are so awkward that while I am paying so high a fee for the Laboratories it will be worth my while to devote my time pretty exclusively to Chemistry at present. When the Exam. is over I hope to get a little painting done. Now good-bye for the present.

"I am, thy ever affectionate son,
"S. P. THOMPSON."

One of those with whom he made acquaintance during his first term was Mr. Raphael Meldola, then working under Mr. Lockyer (afterwards Sir Norman) at solar and spectrum photography. In November he writes :

"Meantime, I mean to make the best use in the present of the chances of the hour. Mr. Meldola gives me freely the welcome to slip in and out of his place during the next few days. I shall learn something practically of the rare arts of solar and spectrum photography, and of the graphic methods by which the photographs are reduced to scale on to the accurate charts now being constructed."

In a month's time Professor Frankland had recognised the gifts of young Thompson, and told him that he ought to aim at the highest walks of the profession, and look out for a Professorship in a few years' time. Advising him to attend the Lectures at the Royal Institution, he promised

him tickets for the Friday evenings, when the session began after Christmas.

In a letter dated December 10th Thompson writes :

“MY DEAR FATHER,

“I have just come in from the Royal Astronomical Society, to which I was admitted a Fellow this evening. Fellows have not only to be elected¹ but ‘admitted’ in formal style. I didn’t get admitted last month, because I wanted to wait to see how the operation looked. At a certain stage of the business the Secretary announced that the present is the time for receiving newly-elected Fellows. Thereupon the new Fellow rose from his seat amongst the mass of persons facing the President, walked demurely up the dais, signed his name in a big roll-book, with all the customary embellishments of flourish, and was handed over to the President, Adams of Cambridge, of Neptune-discovery renown, who grasped my hand as gingerly as if it had been a dead fish, and calmly mumbled, ‘Mr. Thompson, in the name of the Royal Astronomical Society, I admit you a Fellow thereof.’ And the newly-admitted Fellow returned to his place.”

When the lists of the B.Sc. examination came out, Silvanus found himself bracketted first in Honours.

Owing to his own and his father’s position at Bootham School, he had many introductions to members of the Society of Friends in London. Attending one of their largest meetings, situated in St. Martin’s Lane, and known as Westminster Meeting, he was very soon a welcome guest in many of their homes. Alfred W. Bennett, a noted botanist and lecturer at University and Bedford Colleges, made his home a centre for students of the Quaker faith. One of the Tatham cousins also, daughter of Joseph Tatham of Leeds, who was the wife of J. Bottomley Firth, M.P., lived in South Kensington, not far from Robert Street. Sir

¹ Thompson was elected because “he was a most promising student to become an astronomer, and a very suitable man to join the Society. At that time the claims of candidates were scrutinised.” As to his claims see p. 8. He had also, whilst a master at Bootham, given a special course of lectures on astronomy at one of the other boys’ schools in York.

Jonathan Hutchinson the surgeon, Sir Edward Fry the judge, and John Bright, also attended the same meeting.

Almost every Sunday was spent in some hospitable Friend's home, and he became a member of a small literary and artistic circle called the Friends' Portfolio Society, to which he belonged to the end of his life, frequently attending the monthly gatherings.

Through the interest of Professor Guthrie he had been attending some of the meetings of the Physical Society, and about the middle of December he was elected a member.¹

The Society was then comparatively new, but rapidly increasing in popularity. Its president that year was Dr. John Hall Gladstone, F.R.S., Professor at the Royal Institution, and a renowned chemist. Unlike so many of his contemporaries he was a man of deep Christian faith, and young Thompson found in his home a most congenial

¹ Silvanus Thompson was in later years President of the Physical Society for two successive years, 1901-2. In his first presidential address he gave the following account of the Society's inception and purpose:

"Our Society was originated by teachers of physics at the instigation of the late Professor Guthrie, our founder, whose memory many of us cherish with a personal regard and affection that goes far beyond the high esteem in which his name is deservedly held for the good work which he did as an experimental investigator of great originality. From its inception the Society has been actively supported by the teachers of Physics in the Schools and Colleges of London, as well as by the Professors of Physics in the Universities and University Colleges of the United Kingdom, and by the Lecturers in Physics of the great Public Schools. While we would all acknowledge our great indebtedness as a Society, and in the pursuit of Physics generally, to those non-professional members who have contributed so much to the advancement of science, and who in Great Britain have ever held so striking a position as scientific pioneers, there is a special sense in which we may appeal to all teachers of Physics, from the most elementary to the most advanced, to make use of the Physical Society, and to give it their active support. It was mainly in the interests of teachers and students that the Physical Society originally undertook the publication of the *Abstracts*, the purpose of which was to keep English students of physics informed of the latest steps in scientific advance wherever published. The teachers of Physics throughout the country, by coming into membership in the Physical Society, will find in its meetings, its discussions, its Journal of Proceedings, and in *Science Abstracts*, a real help in following the progress of research, and may derive many suggestions of the most direct service to them, both in their daily work in the lecture-room and the laboratory, and in any original investigation in which they may be engaged."

atmosphere. He frequently visited there on Sunday afternoons, and sometimes joined a Bible class of young men, which Dr. Gladstone taught in his own house.

As soon as the Royal Institution opened for the session, Thompson hastened back from his Christmas visit to York, where there had been a happy family reunion. He attended diligently Tyndall's course of Lectures on Electricity, and in a letter to his mother of January 6th, 1876, he says :

"Tuesday brought Lectures and Classes 'as usual,' except that I had to run away in the middle of Guthrie's discourse on Electricity to be in time to hear that by Tyndall, who, very curiously, was on precisely the same part, and performed the very same experiments:—but oh! with such a difference. There is a dash and an ease about Tyndall's speaking and manipulating."

Again he writes :

"Tyndall's Lectures concluded last Saturday. I have made very full notes and embellished them with about eighty scribbles of apparatus, experiments, and portraits. They were, as examples of popularized science, admirable; the illustrations brought forward being most excellently adapted to teach the subject. I have learnt a good deal of the method and 'technic' of lecturing by them, and have had the opportunity of seeing, what we do not get at all in Guthrie, and very little in Frankland, the swing, the ease, the dash, that makes all the difference between the easy and the tedious lecturer."

A few days later he went to hear another of the famous lecturers of the day, Professor Huxley, "Upon the Comparative Anatomy of the Lower Vertebrata." He writes :

"May I never hear an uglier man discourse worse upon as unpromising a topic. The flow of language was perfect, and the whole manner most graphic, perspicuous, and simple. As a speaker he beats Tyndall hollow."

He also attended Dr. Gladstone's Lectures, chiefly on the past history of chemistry, which he greatly enjoyed. The

historical side of Science always appealed to him, and in later years he spared no pains to trace its obscure origins, his good linguistic equipment being invaluable for this purpose.

On January 21st he wrote :

“ To-morrow morning I go to Dr. Guthrie’s room in the Physical Laboratory, where we are going to give the day to investigations upon a new form of electricity lately discovered (by Dr. Beard of Baltimore ?). It will be very pleasant to be associated with Dr. Guthrie in this work. What it will lead to I scarcely can tell yet.”

A few days later he wrote to his eldest sister Maria :

“ Monday night, and all my spare time, has been given to the investigations that I am assisting Professor Guthrie with. I shall be at work with him to-morrow, and probably all Saturday. We cannot yet say that much result has followed our experiments upon the new electrical force, but we hope to get on a good stage on Saturday morning.”

To his father on February 4th :

“ My work with Dr. Guthrie came to a temporary lull on Saturday afternoon last, when, having completed for the time the investigations in hand, I communicated the substance of them to the Physical Society in a paper which you will find briefly reported in this week’s *Athenæum*. We had a very interesting discussion about the new manifestation afterwards. It is originally an American discovery, but the men over there fancy it to be a new force, while our experiments go to show that it is simply a variety of induced electricity.”

This was the first published research of Silvanus P. Thompson, and was afterwards reprinted under the title, “ On some Phenomena of Induced Electric Sparks ” in the *Philosophical Magazine*, September 1876, and the *Proceedings of the Physical Society*, vol. ii.

Thompson had carried out a series of experiments in which he obtained sparks from conductors placed near the



PROFESSOR TYNDALL LECTURING TO A JUVENILE AUDIENCE AT THE ROYAL INSTITUTION, 1876

From the collection of the Royal Institution

coil of an electromagnet at the moment of interruption of the current in the coil. He was trying to account for the production of these sparks in terms of the already known laws of electricity, not ready to accept the hypothesis of a new force if an old one would suffice. The apparatus was several times altered in design to give increasingly powerful sparks, such as could be discharged through vacuum tubes, and the discharge observed in a rotating mirror, when its alternating character and irregularities became apparent. It was established that the charges on the conductor were obtained on interrupting the current only in circuits in which there was an air gap, however short. Thompson believed that he could account for the momentary charge in the conductor as being induced by the temporary accumulation of electricity which was necessary to produce sufficient electromotive force to break down the resistance of this gap.

A week later he wrote :

“ Dr. G. has left me now almost alone ; he was with me about five minutes on Saturday in fact. I am glad to say that further investigations are very satisfactory, and that I have now been able to frame a theory that will account for the entire series of phenomena.”

He communicated this to the Physical Society about a month later.

It was about this time that Mr. William Crookes (afterwards Sir William Crookes, O.M., and President of the Royal Society) gave his memorable lecture on the “ Mechanical Action of Light ” at the Royal Institution. He then showed his radiometers, “ marvellous little mills of pith and glass, which revolve by the action of light alone, in a perfect vacuum.” So Silvanus, who was present at the lecture, taking numerous notes, described them. Shortly after he went as a visitor to a meeting of the Royal Society, where he was introduced to Mr. Crookes, and “ had a chat with him on radiometers.”

The Friends of Westminster Meeting were in the habit of arranging social gatherings during the winter at which

lectures were given. That year they had already had two by Alfred W. Bennett and by Sir Edward Fry, and Silvanus Thompson was asked to give them one on a scientific subject. He chose the subject of "Comets: their Purpose in the Universe in the Light of Recent Research," showed many diagrams, and used various illustrations, including some of the newly discovered radiometers. In his letter describing this to his father he writes:

"Monday was a hard day with me. After Dr. Frankland's lecture I was working all day with the mercurial air-pump exhausting a Radiometer I had devised. I got special leave to stop, and went on till half-past nine at night, when the exhaustion was fairly completed—when to my great annoyance, in sealing off the vacuous tube with the blowpipe, the glass cracked and spoilt the day's work, besides precluding the possibility of having the thing to illustrate my lecture as I had hoped."

Next day, however, he managed to borrow two of the novel instruments from a scientific shop in the Strand.

He wrote:

"Happily I had, for the sake of brevity, written out in complete pithy sentences the introduction, which dealt with the general constitution of the Universe and the places therein occupied by stars and planets; and also I had a similar written conclusion. These I found a great help, as they certainly saved time. My audience listened as though they would eat me, especially during my remarks on the reign of law. I don't mean they looked ferocious, but so perfectly attentive."

Among the audience was a young girl who had just left school, who was later to become the wife of the lecturer. She was the eldest daughter of James Henderson, a member of the congregation with whom young Thompson had already become acquainted. She was interested in Science, and had already heard Huxley, Spottiswoode, and other good lecturers, but she much appreciated the powers of the young lecturer, and especially admired the beautiful peroration with which he closed.

After Easter he wrote :

“ MY DEAR FATHER,

“ I sent off a card at 5 p.m., in which I said something about writing concerning a post now vacant. There is a new University College now being established at Bristol of which I heard a good deal last summer. It will open in October, and they have been advertising for a Professor of Chemistry. I saw the advertisements about a fortnight ago, but felt inclined to pass the matter by as rather beyond my sphere at present.

“ However, a few days ago Mr. Lodge, Prof. G. C. Foster’s right-hand man, with whom I was having some chat, said : ‘ Why don’t you go in for Bristol, it’s the very place for you.’

“ After thinking the matter over, we agreed that, clearly, nothing could be done without consulting Dr. Frankland. Accordingly this morning I waited upon the doctor, and asked his opinion.

“ He told me that one other gentleman had been to him on a similar errand, and he would give me the counsel he gave him, to wait and try to find out who was intending to apply. I could not gather, though I suspected it from his manner, that he had someone in the corner of his mind.

“ Then he spoke of his satisfaction at the way I had been working since taking a place there, and his belief that I should, when a little better known in the chemical world, have no difficulty in taking a good place, as he thought I had capabilities for the work of the best posts. I cannot report all, but I left the doctor with a respect for him, certainly heightened by the manner in which he had expressed himself ; and certainly gratified at the cordial way in which he had spoken of his appreciation of my work. I am quite sure that I shall have his hearty good will in the future whenever I have to apply to him for testimonials, whether this matter come to nought or no.

“ I had a very hard day’s work on Saturday last ; for instead of going to see the Queen drive up to the Exhibition, I was putting together apparatus for my final discourse to the Physical Society upon the newly investigated electric sparks. I have got to the end of the matter, and won my spurs in Physics. Prof. Adams of Cambridge, and his son, Prof. Adams of King’s College, were present—and about two dozen other Professors—also a lot of miscellaneous members.”

He decided to apply for the chemical post at Bristol, and began collecting testimonials from the scientific men whom he had met, and who appreciated the work he was doing. He had already received some good ones when another opportunity came to him to show his powers of lecturing, as he described to his father :

"I was met with an urgent message from Dr. Guthrie. I went to him and found him. He told me he had just been, telling Major Festing that I would give a twenty minutes discourse on Radiometers at the Exhibition ! My astonishment may be imagined. It appeared that someone was advertised to explain the instruments at 1.30 p.m., and could not come. Major Festing had come in a hurry to Dr. Guthrie, who had forthwith assumed that I could, would, should perform the work. It was now 1.15 p.m. Just a quarter of an hour. I rushed over. Some of the people in authority got the various apparatus out of the cases. People were dropping into the Conference Room in anticipation. Half-past struck. Then I marched into the room with Major Festing, who briefly introduced me to the audience. Right opposite me the only man of the company I recognised was Father Perry, the celebrated astronomer of Stonyhurst. I am told there were about eighty people present, including Professor James Thomson of Belfast (brother of Sir William). My discourse of twenty minutes was listened to with great attention, and the experiments were in every way successful. Then I rushed back to the Museum to swallow a mouthful of lunch, and prepare for the Physical Society's Meeting, which was well attended and interesting. My description of the Hepworth Clock (electric) lasted just five minutes—the discussion which followed nearly ten. Major Festing came up and wanted to know whether I would consent to repeat my discourse on Radiometers on Monday and Tuesday next at the same hour. I considered whether I would and could repeat the discourse, and finally consented. It is lucky that I knew something of these new instruments and their history ; and of course this is a good advertisement of oneself without much labour. So on this ground I accepted his offer. I only wish he would ask me to give an evening lecture of an hour's duration on 'Induced Electricity' to astonish the natives."

About the middle of June, by the advice of some of his

Bristol friends, he went down there and visited several of the Members of the Council of the New University. Among them was Dr. Percival of Clifton College, who, as he wrote, "received us courteously."

"I am a little afraid of Dr. Percival, as he looks the kind of man who is able to look you through, and reckon you up at a glance. His questions were straight to the point, but few. When he asked me if I had taken honours at my degrees, it was a comfort to say that I was first in honours at the B.Sc. As he is a great friend of Edward Fry's, however, I do not dread him much, as Edward Fry has (like Dr. Frankland) given me his card and permission to use his name as a reference in respect of general culture and scientific standing."

Thompson did not succeed in obtaining the appointment of Professor of Chemistry at Bristol, which went to Dr. Letts of Belfast. Almost immediately after, however, the Council of the College advertised for a Lecturer in Physics, and he, at once applying for that, was duly appointed to the post.

CHAPTER III

LECTURESHIP AT BRISTOL AND EARLY RESEARCHES

WHILE awaiting the news of the result of his application for the Bristol post, Thompson decided that in preparation for it he would carry out a plan, already made some weeks before, to visit the University of Heidelberg. One of his former colleagues of Bootham School, Alfred Kemp Brown, had proceeded for further study to that University, and correspondence with him had suggested to Thompson the idea of spending a summer vacation there. He wished to watch the working of the laboratories of the University and also to perfect his knowledge of German.

He spent the first part of his time abroad, going leisurely up the Rhine, for he was very fatigued by his strenuous year's work. Again he wrote journal letters home describing what he saw and learned on his travels. This time the pages were illustrated by clever little pen and ink sketches. On reaching Bonn he visited Doctor Geissler, the maker of the celebrated Geissler's tubes, and of Radiometers of various kinds. He found him very ready to explain everything, and was able to acquire some of the newest appliances for illustrating his future lectures. He also saw the University and was taken round the Chemical Laboratory, where he reported that he found nothing new, worthy of remark.

He stayed at several of the little places on the Rhine--Rolandseck, Bacharach, Boppard--enjoying the novelty of being among people of such different manners and customs, which he described with many humorous touches.

On arriving finally at Heidelberg he took lodgings in a pension, and settled down to attend every day the lectures of the Chemical and Physical Professors.

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After receiving his first letters from England he sent the following news to his former master, Professor Guthrie, F.R.S.

“HEIDELBERG,
“*July 29th, 1876.*

“DEAR PROFESSOR GUTHRIE,

“I have learned to-day, and hasten to tell you, that the Council of the University College, Bristol, have decided the Lectureship in Physics, and that the election has fallen upon myself. I feel that I cannot allow a day to pass without sending you this news, together with my most cordial thanks to you for the assistance you have rendered me in obtaining this post—assistance without which my candidature would have been one with little prospect of success. I shall have cause to thank you, not indeed for this alone, but for the unvarying kindness I have experienced at your hands, and for the many ways in which you have assisted me in my studies.

“I hope on Monday to place in the hands of Herr Geheimrath Bunsen, the letter of introduction you have so kindly furnished me with.”

Silvanus was delighted with the free and unconventional life at Heidelberg, and with the picturesqueness of the old town. He wrote to his father :

“Bunsen the chemist is a well-known man, and is worth hearing. Let me describe one of his discourses.

“Lecture-room, a stuffy hole with high table all covered over with bottles, flasks, and glasses—semicircular rows of forms to accommodate about ninety students rising opposite, and a great noise occasionally coming up from the street outside.

“Punctually at 9 o'clock by the little Dutch timepiece clacketty-clack-ing away against the wall I enter. There are two students present. I take a seat and look round. Presently an officious looking young man brings in three very respectable and sedate gentlemen, evidently not Englishmen, and very much sunburnt. One of them has a long grey beard, and another a beard of black, grizzled, and they take seats in the front row. The officious young man bows deeply thrice and retires. Six minutes past, and there are two more students. Then a distant bell-rings, and a troop of thirty more pour in through the door and

scramble to their seats, two or three of them smoking cigar ends. Nine minutes past the officious-looking young man reappears; looks at the clock; vanishes. A few more students come dropping in, and each as he comes in is greeted with a shuffling of the feet and a few gentle hisses. Fourteen minutes past nine and a farmer-like looking man with a dirty collar, slovenly coat, untidy hair, and a much wrinkled but benevolent face, slouches in at the doorway, and steps behind the table. Everybody rises about six inches from his seat to acknowledge the bow of the Lecturer, and there is partial noisy applause.

“Without a moment's delay the Lecturer, for this is Professor Bunsen—Herr Geheimrath Bunsen—begins his discourse in an off-hand way without any preliminary words. Meantime the officious young man crawls behind the Professor and crosses to the other side of the room, when he proceeds to put back the hand of the clock to ten minutes past the hour. The discourse proceeds, interrupted only by the shuffling and hissing that salute a late-coming student. The style is without either affectation or dignity; the discourse never stopping for want of a word, and never rising beyond the commonplaces of chemical description, not even ceasing when a little liquid has to be poured into a glass, or a specimen of an ore taken from its place on the table, and handed, via the officious young man, to the nearest student on the front row. All goes on without a hitch or hindrance until the clock strikes ten solemn and almost inaudible strokes. With a deep bow the Professor finishes his discourse and retires through the door. And then we learn that the Emperor of Brazil, he of the long grey beard, was the stranger present.”

With Professor Quincke, whose courses on physics Thompson attended, he formed a lifelong friendship which was afterwards frequently renewed at various international gatherings. In later years Geheimrath von Quincke visited London on several occasions; he was a most genial man, and much liked by some of his English colleagues.

The Summer Semester at Heidelberg was all too soon over, and Silvanus returned to England in time to attend the British Association for the Advancement of Science held that year at Glasgow. Very soon after he went to Bristol, where he found comfortable rooms at St. Michael's Terrace,

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Cotham, and began to get ready for the Session at Bristol University College.

The Council for the University College had not waited for a building to be erected, but had started the classes in temporary premises consisting of some dismal old houses in Park Row. To the Lecturer in Physics was allotted a damp cellar as a store-room for his apparatus, and two rooms on the second floor as lecture-room and laboratory. Professors and students of modern times would be horrified at the inconveniences which had to be put up with.

The first few letters which he wrote to his father give such an excellent picture of the beginning of his work, and of his introduction to Clifton society, that it will be best to quote from them with but few omissions.

His father had apparently been warning him that he had been spending money rather freely, and he justifies himself on spending only what was absolutely necessary for his work, certain pieces of apparatus, etc.

“The other source of expenditure has been books. While in Heidelberg I spent nearly £2 on French and German books, and got some most helpful ones for my work here. On my return to London I got some more, including Ganot's *Physics*, Professor Tait's excellent new book, *Recent Advances*, two books on Physical Measurements and a book on higher Mathematics at which I am taking daily doses. Since coming here I have got several books. I had purposed, a little while ago, getting Guillemin's two beautiful volumes the *Forces Physiques* and the *Applications de Physique*, but they cost 20s. each, and so while I was in London I made up my mind not to buy them. I took also at Kensington a last fond look at Helmholtz's splendid work on the *Sensations of Tone*, a perfectly wonderful book of which I there read a good deal in the spring. Books are expensive, and there is such a thing as knowing where to stop.

“I finished yesterday reading another interesting book that I have got lately—Balfour Stewart on the *Conservation of Energy*, quite a readable book, and one teeming with the latest information. I will bring or send it home some time, as I should like you to see it.

“I am finding ‘reviewing’ profitable. *The Friend* has

added to my Library. *The Unseen Universe, Assyrian Discoveries, Chaldean Account of Genesis, Abbott's Sermons*, and lastly a thick new volume of Dr. Carpenter's *Mental Physiology*.

"I greatly prize this connexion, as reviewing is not laborious work. I am hoping to get some further work of this kind through my friend Conrad W. Cooke (son of Cooke, R.A.) of London, and who 'knows everybody,' and is one of the nicest and kindest fellows I ever came across. . . . Yesterday at 2.30 was the conference of the Professors and Lecturers upon their mutual arrangements, so I had to turn out, hoping to be back in an hour to finish writing to you. Our conference lasted till 6 p.m. ! and we have to meet again to-morrow. My lecture-room looks very nice, but its arrangements are far from complete. I am sorry to say the students are only to have chairs—not regular benches and desks. I did my best to show the unwisdom of this notion, but in vain.

"I have been twice to Cotham Lodge, and find a continued welcome there. Mr. Camps is getting to look 'old—more noticeably somehow than before. The young ladies are very busy over the approaching Musical Festival in which they are to sing in the choir. Hallé's band is coming down, and a lot of noted singers. I shall be in the serener atmosphere of acoustical apparatus, however, when the Festival is in progress. . . . I am to dine with Dr. Percival at Clifton College on Tuesday next, and on Thursday I am to meet a number of Bristol worthies and people concerned in the College at Mr. Carpenter's. When we get to work, too much of these dinner parties won't do. . . . My landlady is a great success, and looks after me admirably in every way. I am very well pleased with the accommodation I have here: rooms airy and commodious, and nothing if not clean. No particular prospect either way; but then I didn't come to Bristol for the sake of the scenery.

"Hast thou not got a copy of the Thompson Pedigree as far as known? I do not think I ever saw it, but should very much like to do so. I suppose it was never printed.

"Dear love to mother and thyself. I do hope you will come to Bristol before Christmas, it would be so nice to have you here for a little while.

"Ever your affectionate son,

"S. P. THOMPSON."

" October 7th, 1876.

" MY DEAR FATHER,

" Before I go down to the College to work at my apparatus there, I must write a few lines, or else I fear I shall get nothing done to-day. My lecture-room (which I share with the Mathematics) is ready at last, and I have got already full cupboards, though there yet remains a heap of things to unpack.

" My first Lecture will be on Wednesday at 11 o'clock. Evening lectures don't begin until the 16th, and I have to give an hour on Tuesdays and Thursdays. I have a fair promise of attendance. Sundry young ladies for the morning course, and several clever young fellows. Amongst them a Richardson of Newcastle, a nephew of Dr. Tuke, who is here to study with Dr. Letts. I have also some men who have taken the Whitworth Scholarships, and one of them has been through a Mathematical and Chemical course at Owens. *Tant mieux.* •

" Scholarship Examinations are over, the robes came just in time. Thanks very many for them. The hood, lined with white silk *à la convocation*, looks very nice.

" I have not yet unpacked the Electrical machines, because my store-room in the basement is not yet ready, and as it is rather damp, I have not been sorry to wait till it is a little dryer.

" I dined on Tuesday at Clifton College, the whole staff being invited to meet the Mayor of Bristol. We had a gorgeous set-out and a stately dinner. I sat next to Miss Catherine Winkworth, the authoress of many hymns, *Lyra Germanica*, translated from the German. After the dinner we adjourned to the lesser Colston Hall, where there was a prize-giving by the Mayor and Dean, of the South Kensington prizes to evening classes. On Wednesday I dined simpliciter (at 6 p.m.) with Francis J. Fry¹ (a Member of the Council), and we looked at a lot of his apparatus afterwards, and had a pleasant time together.

" Thursday evening was yet another dinner—people wanted to get them over before College begins—at Mr. Carpenter's pretty little villa near the Downs. I was the only non-Bristolian—evidently meant to be the lion of the evening—to accomplish which unexpected part I put forth my endeavours, and found the company agreeable and intelligent; we had much chat and little music until about

¹ Brother of Sir Edward Fry.

11 p.m. This dinner too was ceremonious, and the table decorated most beautifully with flowers."

To the same :

" October 13th, 1876.

" On Sunday last I walked over to Westbury and spent the afternoon with Edward Grubb, and attended with him, in the evening, the Redland Meeting. On Monday I was busy with preparations all day for my opening Lecture, which I found was expected to be a set-piece.

" On Tuesday morning the College opened, Mr. Bousfield giving a quiet ordinary mathematical lecture at 9 a.m. We had not a grand inaugural field day—the Council, in spite of our gentle suggestions, not seeing their way to this. However, the opening address by Professor Rowley (on Modern History) was understood to be *the* opening, and at 11 o'clock the largest of our lecture-rooms was *packed*.

" We had a very interesting lecture, the subject being chiefly a glorification of the advantages to be derived from the study of History. Towards the close the Professor made a smart attack on the popular idea of the culture to be derived from the study of natural science, of which I instantly 'made a note.' The audience were pleased with the lecture, and I was congratulated by Mrs. Percival and Miss Winkworth on the rap I had got. I laughed and said I should see about that. In the evening I was to dine with the Misses Winkworth. Miss Catherine Winkworth, poetess, and active supporter of the Female Educational Movement, is a lively and very affable lady of some five and forty years. Her elder sister must be some years her senior. There was also a married sister present, a Mrs. Collie, also her husband; Professor Blackburn of Oxford, Frank Tuckett of Frenchay, and Dr. Beddow, F.R.S., etc. Dinner was ceremonious but good, and between Mrs. Collie and Dr. Beddow I had some pleasant conversation.

" On Wednesday morning I had to re-cast the end of my address so as to answer Professor Rowley's remarks. I arranged also to have a few experiments. At 11 a.m. the large lecture-room was considerably more than half full, about 90 to 100 being present.

" Followed by Lewis Fry, Dr. Caldicott, Mr. Shacht, etc., etc., I solemnly entered the room, robed and hooded, and took my place.

" My lecture, which I timed for one hour, took just



BRITISH ASSOCIATION, TORONTO, 1897. THE
DISCUSSION CONTINUED ON THE HOMEWARD
VOYAGE.



SYLVANUS P. THOMPSON AT THE AGE OF
TWENTY-FIVE.

sixty-three minutes to deliver, and the experiments were very successful—as I meant them to be. I had little applauses several times, and a good round at the end. Lewis Fry and Mr. Shacht came afterwards to thank me personally. I hear that it was thought quite a success as an address; and that my answer to Rowley was at once complete and quiet. In the evening was a *soirée* at the Museum, I exhibited several bits of apparatus, and contrived in the intervals to get a good deal of chat with sundry people—Dr. Percival, Dr. Beddoe, Dr. Shingleton Smith, Dr. Tilden [afterwards Sir William Tilden, F.R.S.]. The affair was a great success, over 800 tickets having been sold.

“This morning was my second lecture, I had twenty-two students present, the nucleus with which I start work.

“We are to have an inauguration of the evening classes at which I am to speak—but my first evening lecture will be on Tuesday. I am quite falling steadily into the work of the College, and am enjoying it thoroughly. My colleague, Mr. Bousfield, I like more and more. He has a capital knowledge of Physics, and we have many a chat together. We hope to do a little research together by and bye—if we have time, that is.

“I am astonished how much easier it is to me to lecture now than it was at York. No doubt the number of lectures I have heard during last year, and the utter attention of my students has something to do with it. The apparatus is now very nearly all here, and looks very nice—only I wish we had a little more of it. I am afraid I shall a little exceed the allotted sum, but hope it will not be so. Another year, if the Lectures of the present term are successful I shall be sure of another grant. The stingiest of the Council—or I should say the most cautious—remarked how nice it looked. I instantly turned upon him afraid to lose so good a chance of working the point:—the procuring of some additional apparatus. ‘That, Mr. Thompson, must depend on the results of the present session,’ was the rebuke I received.

“Dear love to mother and thyself. How quiet you will be with all the girls away! Happily you have Fan at school near, and she will be at home to-day (Saturday). My love to her too. What is Tom thinking of doing when he leaves Harrogate? Won’t he try to see something of the merchant aspect of his business in London for a few months. • I am persuaded it will be very greatly to his advantage.”

The two younger sons of Silvanus Thompson had both started on what their father hoped was to be the training for their future careers. Thomas had been learning the tea trade, he was never interested in business, was devoted to music and drawing, and so he did not care to take his brother's suggestion of striking out boldly. Finally he entered the old family business of Tatham & Sons at Settle, where he lived for many years, spending all his spare time over carving, drawing, or music. The youngest son, called after his maternal grandfather John Tatham, began to study pharmaceutical chemistry. He had been apprenticed to a firm in Scarborough, but had a serious attack of pneumonia during 1876, and it was not thought wise for him to return to the bleak East Coast. The father had to break off his indentures at considerable loss, and was rather puzzled what to do with the boy. With the unselfishness characteristic of him throughout life, the elder brother offered to have him at Clifton; the mild climate was just what was needed, and he could help his brother in the laboratory and with lecture preparing. The parents were delighted with the plan, and Silvanus found much pleasure, if also some anxiety and responsibility, in the company of lively Jack, the spoilt boy of the family.

" December 1st, 1876.

" MY DEAR FATHER,

" We had been expecting to hear from you to-day, and were quite disappointed when no letter turned up this morning. However, we suppose that mother is better, or we should have heard. I do hope she will soon be able to get about the house as usual.

" Jack is going on very well with me. He works hard, and enjoys the work, though the hours are long, and he gets very tired. He is really interested in the work and in the lectures, and is a really valuable help to me. He finds time to do a lot of drawing, too, of which I am glad, as it gives him occupation, while I am studying at home. As to anything further for him in the future, I do not see any clear course, though I have been keeping my eyes open.

" We must leave it for the present, what he will do, if for no other reason that circumstances do not enable us

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to see far ahead. Meantime I will bear in mind thy suggestions and wishes, and, as before, keep on the watch for opportunities. On Tuesday we ransacked the garrets of the Museum, and found an ocean of fine apparatus. Two glorious air pumps (one must have cost £60) in good condition, but more than inch deep in dust, and quite forgotten. Also 70 cells of Wollaston's battery. A large plate-glass electric machine. A battery of 12 Leyden jars, each of $2\frac{1}{2}$ gallon size!—and an Attwood's machine worth at least £50 at the present moment, besides a lot of lesser apparatus.

“I shall have the opportunity of using all of these things for my Christmas Lectures, and they are literally ‘a find’; but there will be some red tape to go through before they can be used for the lectures of the College Course—if indeed they can be got at all for that. You should have seen the figures that Jack and I cut amongst the dust.

“As to the Christmas Lectures, everything seems to promise favourably. There are but 350 seats in the Lecture Theatre—which is a capital room for the purpose. More than 130 tickets have been already sold, already expenses are cleared. Francis J. Fry is delighted with the outlook.

“I now have fifty-two students, morning and evening together. A most successful beginning. I am beginning to think seriously whether I shall not try for the D.Sc. examination next June. The thing is worth doing undoubtedly, but it will require every spare moment, from the time my lectures are over, until the day of the examination. Then there is the question in which branch shall I attempt it? Either Electricity and Magnetism, or Physical Optics and Sound, or Physical Optics and Heat?”

The city of Bristol possessed a very good Museum and Public Library, attached to which was a hall, well fitted both for hearing lectures and seeing experiments, the seats being arranged in tiers in a semicircle. Here by the invitation of the managing council of the Museum, Thompson gave six lectures on “The Forces of Nature” adapted to a juvenile audience.

They were a great success and much appreciated by large audiences, the exposition was clear, and the experiments went well. They included the subjects of Sound,

Light, Heat, and Electricity, two lectures being devoted to the last-named.

These lectures established his reputation as a good popular lecturer, and he began to be in request to lecture in other places. He consented to undertake some work under the Gilchrist Trust, and during the next few years lectured under their auspices in many towns in the neighbouring counties, at Taunton, Bridgwater, Cheltenham, Weston, etc., and he is still remembered by many hearers.

In May of 1877, Silvanus and Bridget Thompson visited their sons at Clifton, and were much pleased and satisfied with their work and surroundings. This was the only time their father was able to come south, as he became increasingly disabled and enfeebled by severe headaches as years went on.

Despite his lecture engagements, Thompson still continued his researches in physics, and as the London Physical Society's meetings were held at the week end, he was able to attend many of them, bringing to them the "fruits of his industrious labours."

He was also able to keep in touch with the many friends whom he had made during his student days, and frequently stayed till Sunday night with Dr. Gladstone and other friends.

On these occasions he was generally to be seen on Sunday morning at Westminster Meeting House, where he was welcomed by many. During his student days he had formed a friendship with another science student who was at University College, Walter Palmer (afterwards Sir Walter Palmer, M.P.), a member of the Society of Friends. He and Thompson kept up a correspondence for many years. In 1877 the two went to Switzerland together during the long vacation. So the quiet home circle at York was again enlivened by journal letters describing this tour. They went up the Rhine as Silvanus had done the previous year, but did not linger long. He mentions a visit to Strasbourg, "going minutely over the laboratory of Professor Kundt, and being well pleased with what he saw." At Zürich they made a short stay to see its splendid University. He wrote:

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"This morning we paid a visit to the Physical laboratory, also went over the Chemical laboratory in the Polytechnicum attached to the University. There is here the most complete and excellent Engineering school in Switzerland—probably in the world. This we went over also, and were immensely pleased with what we saw."

The two young men were on climbing bent, but the weather was very unfortunate for either that pastime or for sketching. After walking over the two Scheideck Passes and the Grimsel and then up to Zermatt, mostly in rain and clouds, they crossed the Théodule into Italy under the guidance of Peter Taugwalder, one of the three survivors of the Whymper expedition. On the way over the Pass, the day being a glorious one, they climbed the Little Matterhorn. Silvanus wrote :

"We stood upon the top feasting our eyes upon the magnificent circle of peaks that wound around on every hand. Such sights come seldom in a life-time. When they do, they awaken emotions and thoughts very difficult to forget—still harder to express."

Much invigorated by this holiday and change, Thompson returned to prepare his papers for the Meeting of the British Association at Plymouth. He read there four communications. One was the first part of a long research on "Binaural Audition," or "Hearing with Two Ears," which was not completed for several years, and which helped to gain for him the recognition of the University of Königsberg, which granted him the honorary degrees of M.D. and C.M.

To aid him in demonstrating electrical experiments before very large audiences, Thompson had devised a form of lantern Galvanometer. This he described and showed at Plymouth. It was mentioned in *Engineering* of Nov. 2nd, 1877, and was pronounced to be an exceedingly simple instrument, which met the requirements of a good lecture-room galvanometer in a remarkable degree. At the Meeting at Plymouth Sir William Thomson spoke of the arrangement as "a most valuable instrument," and said

that, " whenever he had occasion in future to explain electrodynamic phenomena to a large audience, he should certainly avail himself of Mr. Thompson's beautiful arrangement."

At the opening of the Autumn Session at Bristol University, Thompson gave the Inaugural Lecture which was later published as a pamphlet entitled *The Methods of Physical Science*. First explaining carefully the terms " phenomena," " experiment," " law," the lecturer went on to show, by a wealth of reference to the early history of Physical Science, that law could only be deduced from the observation of phenomena, after experiment which proved the facts.

In the course of his historical account of scientific progress he referred to Dr. Gilbert, the Elizabethan writer on magnetism, in whose work he was then beginning to be much interested. In enumerating the methods of Physical Science he grouped them under various heads, Methods of Comparison, Methods of Precision, of Analogy, of Hypothesis, Mathematical and Graphical Methods. He endeavoured to show the value of these methods in the training of the mind.

" As a mental and moral training, the pursuit of the scientific method is absolutely priceless. Just think of what is required of him who would accurately perform a single crucial scientific experiment. It is a moral and intellectual training second to none. The will must be brought into active and perfect obedience. A keenness of moral integrity is requisite equal to that demanded of any man in any study.

" And the further we penetrate and explore, and the more we heap up to ourselves the treasures of scientific knowledge, the more surely do we become persuaded of the aptness of that beautiful simile of Newton's, that he who has learnt most widely and most deeply is yet but as a child gathering pebbles under the blue sky, upon the shores of a boundless ocean."

Mr. William Crookes, then editor of the *Quarterly Journal of Science*, wrote to the author :

" It has given me so much pleasure that, had I known of this address earlier, I should have been happy to have printed it as an ordinary article."

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During the Christmas holidays (1877-8) Thompson gave another course of six lectures to juveniles on "Voltaic Electricity." These required a great amount of illustration and experiment, and occupied much time in preparation. In attempting to explain such subjects to children, he was following in the footsteps of Faraday and Tyndall, and from the latter he received a short note: "I wish you success. Your movement, depend upon it, is an important one."

The lectures were brilliantly successful, and the experiments so ingenious, that next year he received a letter from Mr. Preece (afterwards Sir William H. Preece), of the Post Office, asking if he could help him by suggesting some experiments for some similar lectures at the Society of Arts. This led to some correspondence, and many suggestions from Thompson.

Mr. Preece wrote :

"I send you herewith a copy of the lecture I gave at the Society of Arts. You will see I used two of your experiments.

"I think your ear *idear* a splendid one, and hope you will carry it out sooner or later. I give you a rough sketch showing how we made the hat speak. It is a very simple experiment, and very telling. With many thanks.

Believe me, yours sincerely,

W. H. PREECE."

At this time Thompson was in frequent correspondence with Professor Guthrie in regard to the result of researches which he was communicating to the Physical Society. In December he wrote :

"Many thanks for your kind offer of help for Saturday. I am very sorry that I cannot come up for the day: engagements are too pressing. Prof. Reinold has my paper, and the specimens of films are under the care of my friend Conrad Cooke, who will do ample justice to them. There remains consequently nothing further to ask you to do, unless you think it might be well to have some other wire frames, and a Plateau's soap solution in order that the Society may see in what respects the fixed films resemble

or differ from the true cohesion films of Plateau. You will find my fixed films disappointing in not yielding chromatic phenomena. They burst before setting hard, when made as thin as one twenty-thousandth of an inch.

"You are in error in addressing me as 'Professor.' The Council of our College are discussing the question of turning the temporary Lectureships into chairs—but have not done it yet. So I have no claim to the title."

This letter refers to a research on soap films communicated to the Physical Society, and afterwards published under the title of "Permanent Plateau's Films."

The day after Thompson's paper had been read he received a letter from his friend Mr. Oliver J. Lodge, saying: "Your permanent films went off all right to-day at the Physical. It is jolly being able to have hard ones like that. Their strength is remarkable."

In January of the following year Thompson began working at magnetical problems, and several interesting letters passed between him and Professor Guthrie. On January 10th he wrote:

"I made a rather interesting observation yesterday, which I wish to inform you of, as I think it may be worth while to repeat it before the Physical Society. I have neither the time nor the means to prosecute the subject further at the present time. The observation is as follows: The resistance experienced by moving bodies in traversing a magnetic field is experienced also by vortex rings as they cross such a field. My experiment was made with vortices of coloured liquid, in water, passing either through a coil of wire carrying a powerful current or between the poles of a powerful electromagnet. The resistance was not, however, sufficiently great to completely retard and destroy the vortices, and I am desirous of knowing whether this would be the case if a battery of 60 or 70 Groves' cells were employed to excite the electromagnet. I am sorry I have no prospect of being up at any approaching meeting of the Physical Society, or I would have asked your permission to take advantage of such an occasion to make some further experiments in your laboratory."

With regard to the researches made at this time a rather curious occurrence took place in connexion with a paper on "Some Magnetic Figures made by Means of Iron Filings," which Thompson had shown at the Physical Society, and which had been apparently accepted as a new piece of research. However, afterwards Professor Guthrie admitted in conversation that these were not new to him, and the following letter from Thompson explains itself, and is characteristic of the man:

"I have been thinking over the question I put to you last Saturday, as to whether my filing-figures were *new* to you, and feel a little puzzled how to act on your reply. I wish I had been able to see you in the morning, that I might have learned then that you had preceded me in this little item of research, for it was relying on the opinion of Prof. G. C. Foster and Prof. Adams that they were new results that I was induced to show them to the Society. And of your generosity in not publicly stating your previous knowledge of them I know not what to think.

"But the difficulty of the situation to me lies here: that I am placed in the position, when I contemplate publishing the paper, of being about to claim for myself what I know to belong to another, though I arrived at it independently.

"It appears to me that three courses are open to me:

"(1) To publish my series of figures, saying nothing about knowing now that I am not the first with them—a course which I simply refuse to take.

"(2) To publish the results as far as they go, adding that I have been informed that you have already done the very thing.

"(3) To ask you if you are willing to publish your results, and whether in that case you will accept and embody mine, in part or entire, and stating that I had independently arrived at those which are in my series.

"I want to take no action in this matter that you would not cordially approve, and I hope you will—as I know you will do—answer me with the freedom with which I lay the matter before you."

To this Dr. Guthrie replied that three or four years ago Professor Barrett¹ had shown him some similar figures, but

¹ Of Dublin; now Sir William Barrett, F.R.S.

that he did not claim them as new, and advising him to ask Professor Barrett what literature there was on the matter.

“I have no claim in the matter. But in any case I think it would be well to state something to the effect that you are informed that some of these effects, though unpublished, have been exhibited before.”

Before receiving this advice Thompson found that his electromagnetic figures had already been shown by Faraday, from whose researches Professor Barrett also had got them. He wrote :

“I am surprised, not that I did not know of their existence in Faraday's book, but that no one of the members of the Physical Society knew. I shall have to make the *amende honorable* to Prof. Adams as President. The other results of which I spoke are not described in Faraday.”

During this year also Silvanus Thompson designed some very curious optical illusions which he called “Strobic Circles.” They excited considerable interest among scientific men both in England and France. He had them printed on cards in sets of six, they were entered at Stationers' Hall, and many thousands were sold. They attracted the attention, among others, of Dr. J. Crichton Browne (afterwards Sir James Crichton Browne), who asked that a description of them might appear in the periodical *Brain*, as he thought they were of special interest to those who were engaged in the study of brain and nervous diseases. This was done, and they thus reached a wide public. Professor Stirling, of the Physiological Department of Owen's College, Manchester, wrote some years later to Silvanus Thompson that these Strobic Circles had “amused many a passing moment. If any knowledge I have from the anatomic-physiological point of view is of any use to you, it is at your service *con amore*. Your arrangement of whirling cylinder is excellent.”

The Strobic Circles reached a still wider public when they

were used, with permission of course, by a famous soap maker as an advertisement of his wares.

During this second year of Thompson's Lectureship, when his reputation both as a researcher and as a teacher was growing with great rapidity, the Council of the College managed to collect sufficient funds to endow, very modestly it must be confessed, a Chair of Physics. To this he was elected in the autumn of 1878, the same year in which he had also taken his degree of D.Sc. at London University, in the branches of Optics, Heat, and Sound.

But the progress and growth of the University College was very slow; funds did not come in as freely as had been hoped, and the scientific departments were cramped for space and hampered by want of both proper equipment and of assistance. Professor Thompson no longer had his young brother as a voluntary assistant in his laboratory, and he had to spend much valuable time, not only in looking after his apparatus, but in actually making many pieces himself, which might have been provided for his use. It was not until several years later that he was allowed an assistant.

The College Council consisted of men who had little or no apprehension of the enormous and rapid development which was taking place in the knowledge and teaching of electricity. The Principal also, Professor Alfred Marshall the economist, was not particularly interested in science, so it was very uphill work for any man who was seeking to keep abreast of the demands of the age.

That year he still went on diligently working at small pieces of research which cropped up in connexion with his teaching. He also collaborated with Mr. Oliver J. Lodge, then an assistant to Professor Carey Foster of University College, London, in a research on the peculiar properties of the tourmaline, a semi-precious gem. This consisted of a study of the Unilateral Conductivity of Electricity in the crystals. The important result obtained was the proof of "convection of heat by Electricity analogous to an effect predicted by Sir William Thomson in unequally heated metals (Bakerian Lecture, 1856)." The results of the research were communicated to Section A of the British

Association at Dublin by Thompson. He also read, among other communications, Part II of his research on "Binaural Audition."

The President of that year was Dr. William Spottiswoode, an authority on optical phenomena. Among the Associates of the Meeting were Jane Henderson and her sister, who were staying with some Quaker cousins near Dublin. Jane Henderson was at that time on the literary staff of *The Glasgow Daily Mail*, to which her father had also been a contributor for many years, and she was engaged by the Editor of the journal as special correspondent to write a lively general account of the meeting. The sections where their old acquaintance Silvanus Thompson was showing any of his fascinating experiments were of course diligently attended.

The phenomenon of the rainbow and its optical causes had for long attracted the attention of Thompson, who with his love for painting, and his strong sense of the beauty of colour, had tried to reproduce its marvels. This autumn he gave a lecture to the Bristol Naturalists Society "On some Obscure Points about Rainbows." It was enriched with quotations from poets and writers from Aristotle onwards, and illustrated by a great number of experiments. It created quite a furore among the artistic and literary circles in Clifton, and was talked about for a long time afterwards.

CHAPTER IV

PIONEER WORK IN TECHNICAL EDUCATION

SILVANUS THOMPSON found himself at the age of twenty-seven occupying a post such as he had never dreamt of attaining to when he started on his scientific career. Now he felt the full responsibility of the opportunities which lay before him, and set to work with a will to take advantage of them. Along with most of the earnest young Quakers of his generation, he had not been indifferent to the subject of the social amelioration of the working classes.

He was a diligent reader and great admirer of the writings of John Ruskin, and believed with him that better conditions would arise were the people better educated. Ruskin's idea was to bring this about through teaching the use of museums and the study of art.

At the time when Thompson began to interest himself in a better system of primary and technical education, he had some correspondence with Ruskin, but it did not result in any very practical help towards a solution of the difficulties.

With Dr. John Hall Gladstone, F.R.S., who was for fifteen years a member of the London School Board, he had been in constant correspondence for several years. Dr. Gladstone regarded the education problem from the point of view of a scientific man; Silvanus Thompson did the same. The former was a pioneer worker in trying to obtain a less clerkly education for the children of London, and succeeded, while he was Chairman of the London School Board, in introducing some more systematic teaching of handwork and simple nature study into the curriculum of the schools. But for the older children there was still far too little of this teaching, and the small amount which they learned at school left them only fitted for blind-alley occupations.

Those who entered the industries wasted much of their time in simply trying to be imitators, without having any scientific knowledge of the materials employed, or of the proper use of tools.

Thompson had already found how difficult it was to get pieces of apparatus made in workshops from his own design, exactly to drawings or to scale. Especially for optical research he had found himself obliged to employ foreign workmen to make apparatus for him. He was also far-seeing enough to recognise that industries, electrical, chemical, and optical, were going to develop more and more in the future; unless England woke up to the need of technical education, she would be left far behind in the race.

With his usual thoroughness, he determined to see for himself what was already being done in technical education abroad, in order to acquire a comprehensive grasp of the subject.

He therefore devoted much time during several vacations to making studies of how the people of France, Germany, and Switzerland were dealing with the question, as well as giving attention to what was being attempted in this country.

His first public contribution to the discussion of this problem, which was beginning to take hold of many thinkers of that period, was a paper read at the Social Science Congress at Cheltenham in 1878, entitled "Technical Education, Where it should be given."

After reviewing the condition of scientific teaching in our schools and colleges, which at that time showed only the rudiments of what was really required, he pointed out how the old system of apprenticeship had died out, and something new must be created to take its place. He then gave an account of the *Écoles d'Apprentis* of Paris and Besançon, and of *Gewerbeschule* and *Polytechnicum* of Germany and Switzerland. This paper was subsequently printed as a pamphlet, and when it fell into the hands of Mr. Ruskin, the author received the following characteristic letter from him :

"BRENTWOOD, CONISTON, LANCASHIRE.

"MY DEAR SIR,

"I have read your paper with great interest, and entirely concur in most of its statements and recommendations. But it fatally ignores—what none of our modern thinkers that I know of ever have recognised—the power of race and climate. •

"The sentence—'There is no reason why an English workman should not take,' etc., etc., p. 10—is too fatally false.¹ No good decorative work ever has been done in England—or ever will be. It belongs to Etruscan and Pelagic races exclusively—and in America—no art whatever will be possible these hundred years.

"If you care to look up my published lectures, you will see these statements made at length—and they are irrefragable. You can no more teach an Englishman to paint a wall than a kingfisher to build a honeycomb.

"Ever truly yours,

"J. RUSKIN."

Thompson's reply to this has not been preserved. Not long after he received another letter from Ruskin, which shows his disappointment over his efforts in stirring up public interest in education :

"BRENTWOOD,

"January 25th, 1879.

"DEAR PROFESSOR THOMPSON,

"I have kept your kind letter by me, till in a day of desperate effort to fulfil the duties of the past month—I must try to thank you for it. I am so very glad to hear of anyone 'missing' *Fors.* I hope, however, her work is done—as far as in this present time is needful or possible. I had no conception of the injury it was doing me to live in the perpetual heated air of indignation, an effort or two lately made to resume the index-work have instantly been checked as if I had stooped in the Grotto del Cane.

"Those who see the truth and the horror of existing facts

¹ The paragraph referred to on p. 10 of Thompson's pamphlet ran as follows :

"There is no reason why an English workman should not take just as high a place in the skilled industries as a German or an American workman. When he has the chance of acquiring the training he is in no respect inferior, possessing more independence than the one, and more self-control than the other."

must now deal with them—I can do no more—except by little by little—my index and the ‘essential (absolutely) work of the Mastership till *I* can find a Master.

Ever gratefully yours,
J. RUSKIN.”

“The horror of existing facts” only stimulated Silvanus Thompson to more strenuous endeavours to pursue his advocacy of Technical Education. The City Guilds of London and other City Councils were beginning to take up the idea of providing trade schools and institutes for the better training of youths about to enter the industries. It was therefore most important that these should be started on right lines and adapted to local needs. The ‘Easter vacation of 1879 was spent by him in studying in France the systems growing up there. During the summer he published a slender volume entitled *Apprenticeship Schools in France*. In it he pointed out how in France “The School in the Workshop” had existed for thirty years, giving examples of what he had seen, such as a famous factory for making opera-glasses, the printing of railway timetables, watchmaking at Besançon, etc. The whole volume is full of carefully collected facts about the various types of education for apprentices in that country.

Some months later he received a communication from the Secretary of the American Institute of Instruction at Boston expressing great pleasure in the pamphlet, and asking if the author could suggest any particular lines of inquiry, which would enable their Institute to try to incorporate such ideas as a regular feature in public education. The writer concludes by saying :

“Pray pardon the boldness of this enquiry. The earnest, disinterested spirit which pervades your writings on this subject prompts it. I take the liberty of sending you a copy of some remarks of my own at Philadelphia last year, and I hope to get the subject in its distinctly commercial aspect before our National Board of Trade before many months.”

In a visit to the United States in 1884, Thompson found

how rapidly the idea of Technical Instruction had spread in that country, and was able to gain much valuable information and guidance for future use in spreading the desire for it here.

During the long vacation of 1879 he made a pilgrimage round the Trades Schools in Yorkshire and the North of England, and also visited Glasgow, where a Technical College already existed. In this city he was the guest of James Henderson, then Superintending Inspector of Factories for Scotland and the northern counties of England, with whom he had formed a friendship during his student days in London.

James Henderson had had long and varied experience of social conditions among the workers in different parts of England and Scotland, and was well known as a writer on economic questions.

He was therefore well able to enter fully into sympathy with Thompson's aims, and to help him in various directions.

On leaving Glasgow Thompson went to Germany, and visited the great Technical Institute at Charlottenburg, also those at Hanover and Chemnitz. On reaching Leipzig, however, his investigations were cut short by a very severe attack of laryngitis. His youngest brother was obliged to go to him there, and nurse him until well enough to travel home. He was unable to fulfil several autumn lecture engagements which had been arranged for, but in December he read a paper to the Society of Arts by request.

He chose as his title "Apprenticeship: Scientific and Unscientific." Professor Huxley was in the chair, and there was a large attendance. Thompson began by giving instances of the, in most cases, hopelessly inefficient training then being given in the workshops of this country. He then proceeded to lay down several general principles of technical instruction which ought to be followed in training future workers:

"*Firstly*, in learning to perform any handicraft operation, or to use skilfully any tool or appliance, it is evident that the ability to do that one thing rapidly and well can only be acquired by practice; and that the beginner must learn

by doing the things many times over, slowly and carefully at first, rapidly and well afterwards.

“*Secondly*, whereas in the case of most skilled (and in many so-called unskilled) industries, the craftsman must know how to do a great many things, or to use many different tools, it is evident that the process of acquiring the complete knowledge of the craft will be much facilitated if the learner be not kept doing over again that which he already knows how to do rapidly and well. Having gained skill in one operation by doing it often enough to acquire speed and precision, he ought at once to set about mastering the difficulties of some other operation. If he is kept for months or years doing over and over again that which he already knows to do rapidly and well, employed as a cheap machine simply to put money into his master’s pocket, he is losing just so much time of his apprenticeship.

“*Thirdly*, all practical operations which have thus to be learned by repetition ought to be presented to the learner in a graduated order, best suited to his growing powers; the easy first, the harder as he gains power and knowledge. The round of manual requirements ought to be rationally and systematically arranged.

“*Fourthly*, no apprentice should be allowed to do anything without being shown or told how to do it. It is a point of the utmost importance that the young workman should never be allowed to work unintelligently; the habit of unintelligent working once acquired is hardly ever thrown off. The rational plan is to ascertain first how a thing should be done, and then to do it. This constitutes, indeed, the main difference in many trades between the practical training of English and Continental workmen.

“*Fifthly*, instruction in the general principles of science, which underlie almost all handicraft trades, ought to be taught systematically to the learner by teachers who understand what they are teaching, and who are also acquainted with the practical details of the trade.”

The lecturer then went on to review the whole field of what was being done in this country, pointing out that in the Weaving Schools of Leeds, Bradford, Huddersfield, and elsewhere, there was the beginning of that technical education which was required in every trade and handicraft all over the land. He recounted what he had learned at first hand of Technical Schools abroad. He pointed out many

reforms needed in this country, and advocated the appointment of a Minister of Education. Professor Huxley, in inviting discussion, said that he had listened with the greatest gratification to Professor Thompson's paper, not merely on account of the obvious practical familiarity with the subject which it evinced, and the valuable good sense which it embodied, but for a more selfish reason—because it entirely accorded with the views he had himself expressed, coming to the matter from a very different side. Two years before he had given advice as regards this question which would be found to be in precise accordance with the principles Professor Thompson had laid down. During the discussion, Mr. George Howell, Mr. Hodgson Pratt, and Dr. J. Hall Gladstone expressed approval, with some criticisms, of the ideas “advocated so eloquently” by the lecturer. Professor Perry and Professor Ayrton both thought that England was too conservative to make use of trade schools, and that methods adopted by Continental nations would not suit our people. Professor Huxley, in winding up the discussion, referred to the City Guilds of London which were established to aid their respective trades, and declared that, if the people of this country did not insist on their wealth being applied to its proper purpose, “they deserved to be taxed down to their shoes.”

In later years when, as Principal, Thompson came to carry out practically some of the principles which he had laid down so clearly in 1879, one of his students wrote :

“Technical education was new and on its trial, much less developed in England than in Germany and the United States, and was in England at any rate looked at askance by the ‘practical man.’ He [Thompson] was therefore most anxious to demonstrate to each side the benefits of co-operation between science and industry, and he constantly impressed on his students that when we got to the Works we must keep good time, conform to all the rules, and be willing to do any job assigned to us, however dirty and disagreeable it might be. But while inculcating the necessity of bearing the yoke cheerfully in the workshop, he was also careful to awaken what he called ‘the professional instinct’ in his students, and as one means to that end

encouraged all to become student-members of the Institution of Electrical Engineers and attend its meetings and those of other scientific societies. Such meetings were great times, when we saw and heard all the big men of the electrical world."

Another friend wrote :

"Thompson was always inspiring when he took up the cause of scientific industry. His wide experience brought him endless examples of how to do it, and how not to do it, whether in electric work, glass work, or the dye-stuff industry.

" 'Belittle the teachings of science ; ignore the expert, trained in science,' he would say ; 'carry on your works without him ; if you must pay him, pay him less wages than you pay a fitter ; put him under non-technical directors and managers who know no science. Then, when after years of neglect, your chickens come home to roost, and you find the progress which ought to have been made here is made in foreign countries instead, blame the patent laws, blame the lack of protective tariffs, blame the Trades Unions. Blame everything and anything, except the chiefest cause—the blindness of manufacturers and men to the truth that : that industry is doomed the leaders of which despise and neglect science ! '"

His "gospel of industry" and improved condition for the workers depended most of all on the teaching of science, first in the training of eye and hand in the elementary school, then simple scientific teaching about common objects and natural phenomena, in secondary schools, finally science as applied to tools and processes in the technical colleges.

Thompson's researches during this year had been directed to magnetical problems, the 'Action of Magnets on Mobile Conductors of Current' and cognate questions. But his research work was carried out under great difficulties, and he was feeling discouraged about it.

His friend Professor W. F. Barrett of Dublin, writing to the College secretary thanking him for the College Calendar in '1880, sent a message : "Pray tell my friend Dr. S. Thompson, it appears from your calendar he is killing him-

self with work. His life is too valuable to be sacrificed quite so early."

Besides the elementary and advanced courses in physics and the evening lectures, he gave four periods a week to teaching Geometrical Drawing, and four to Surveying, including during the summer one afternoon a week which was devoted to field practice. One of his old students recalls how they used to go out tramping to some vantage-point, and how, when the work was done, the youths were only too delighted to profit by the kindly good humour of their teacher which prompted him to supply the party with chocolate.

The two following letters to Professor Guthrie tell their own story. They are dated from Carlton Place, Clifton, where Professor Thompson and his brother were then living :

"DEAR DR. GUTHRIE,

"Pray don't be surprised at the occasion of my writing to you.

"It is to ask the favour of your support in my probable candidature for the Chair of Physics in the Josiah Mason College at Birmingham.

"My reasons for contemplating this step are easily stated. Here my opportunities for work in Physics are terribly circumscribed. My lecture-room is used for all sorts of other lectures. My only laboratory is a damp cellar 11 feet by 9 feet. The College cannot afford me any assistant, nor can it afford proper apparatus for any exact quantitative work—they won't even buy a barometer that will read to the tenth of an inch. Moreover, I am saddled with work that I do not care to continue—the teaching of geometrical drawing for example. The change will involve pecuniary loss—at least at first. Nevertheless I must regard opportunities for thought and work as higher than that. You know me, I trust, sufficiently well to speak of my capabilities and work ; and I shall esteem it a favour if you are able to furnish me with some definite evidence to help me in seeking to obtain the post."

* Professor Thompson did not succeed in the candidature for this post, but soon after writing this letter he went

off to Glasgow on a visit to his former host there, James Henderson.

During his visit there in the autumn he had renewed his friendship with the young people, whom he had first known during his student days. The family life was of the same quiet simple Quaker type in which he had himself been brought up. But the three grown-up daughters were all keenly interested in music, art, and literature, and he found much in common with them. So the announcement of his engagement to the eldest was not a great surprise to his family, as he had already hinted to his mother of the object of his journey North.

On his way back from Glasgow he went to York to tell his parents about the new daughter that was to be. After this time letters flew northwards frequently, chronicling the life and thoughts of a lover gifted with no mean powers of expression.

At the beginning of this term there was a change in the staff of the College, Professor Letts having returned to Belfast to the Chair of Chemistry there. He was succeeded by Dr. William Ramsay of Glasgow, with whom Thompson formed a lifelong friendship. They had many tastes in common, though politically they were diametrically opposed. Silvanus, however, took very little part in politics, and detested party tactics. He was, however, a good deal interested in the elections of 1880, as Lewis Fry was standing as Liberal candidate for Bristol.

To his fiancée he wrote in April :

“ I am delighted at the progress of the elections, and the unmistakeable decision against the worst and most unprincipled of modern governments and the flashy froth of the Jew.

“ Our election is to-morrow, I hope we shall be all right ; but it will be a near run.”

To the same next day :

“ We had a very exciting time. The day was fine between the showers, and the city was enormously crowded,

and very gay with party colours. I never saw party feeling run so high before, anywhere. I dined that night with the Wills, the cousins of the new M.P. for Coventry—there were about twenty present—all men—all Liberals—just the lively younger men of the party. After dinner we adjourned to the city—just too late to hear the news of Fry's election, and the speeches, but in time to see the enthusiastic crowds surrounding the newspaper offices, where telegrams were posted. It was rumoured in the afternoon that if either Guest or Robinson got in, there would be a riot. Mounted police were stationed at important points; long cordons of unmounted police lined the thoroughfares about the Guild Hall; and the militia in the Horfield Barracks two miles out were ordered to be in readiness. Happily nothing occurred of a riotous nature. The Conservatives are dreadfully mad and wild at their defeat."

Early in this year he gave a popular lecture on "Heat within the Safety Lamp" at the Bristol Athenæum. This attracted a great deal of local interest, it was largely reported in the Press, and led to a considerable amount both of private and public correspondence. He was now being inundated with requests to lecture in all parts of the West Country, and his duties at Bristol prevented the acceptance of many of these invitations, unless the lectures could be given at week-ends. One course which he gave that year was at Cheltenham Ladies' College. Miss Beale, the successful pioneer of higher education for women, asked him to give a course on Chemistry and Physics to her most advanced students. Owing to the interest he took in the raising of the position of women, he undertook to fit this in among all his numerous engagements. He enjoyed meeting Miss Beale, and they were always afterwards on friendly terms. Professor Thompson was also to the end of his life a steady supporter of women's claims to the franchise.

He was pressed to give the Inaugural Lecture at the Mechanics' Institution, Nottingham, where he again brought forward his plea for Technical Education. Afterwards published as a pamphlet it bears the title *The Apprenticeship of the Past and of the Future, or Trade Education for the*

Working Men of Nottingham. He appealed to the working men to make use of the splendid science school then growing up in their new University College, showing how the new inventions for generating electrical power were likely to revolutionise industry, though the signs of that were "as yet but a little speck on the horizon." He closed with the words :

"It is only the man of weak and sluggish mind who would wilfully miss the golden opportunity in store. For it still remains to be true that to the lower and narrow mind whatever he attempts is a mere trade; but to the mind of higher mould the merest trade becomes a great and glorious art; for in doing one thing rightly he sees the image of all that is done rightly."

Most of the vacations of that year were spent in Scotland, but the happy occasion of the marriage of his eldest sister, Marie, to Elewood Brockbank of Settle took him to York in July. While attending the British Association Meeting at Swansea in August, he wrote to his fiancée about another publication on Technical Education :

"I have a little bit of good news quite unexpectedly to-day. More than a year ago I sent to the Editor of the *Contemporary Review* an account of some of the French Schools. I heard nothing more, and supposed it had long ago gone to the wastepaper basket.

"This morning, to my astonishment, I found the *proofs* of this very article awaiting my final corrections to appear next month, under the title of 'Apprenticeship of the Future' ! I wish I had had longer notice, as some of it really required rewriting. However I have had to let it pass, and am very glad that it will go in. I'll do something better some day.

"My paper on Electric Convection Currents gave rise to some little discussion, but Section A was thinly attended. Altogether the meeting is rather less interesting than usual."

He read several other papers to the Association that year, the most important being an account of the continuation of his researches on the Tourmaline.

In the Education Section, Dr. Gladstone gave an important paper on "The Teaching of Science in Elementary Schools." The discussion resulted in the formation of a Committee, of which he was chairman, and of which Silvanus Thompson was appointed a member, to inquire into the question and suggest improvements. This committee was continued for many years, and sent in reports to the Association annually. Later in the autumn, Silvanus read a paper on the same subject at the Social Science Congress at Nottingham, and again brought forward his investigations into the apprenticeship school system.

Feeling a continued dissatisfaction with the prospects of work in the College at Bristol, it was not surprising that he made other attempts to obtain a more congenial post; these, however, proved unsuccessful, and he made up his mind to settle down in Clifton, and took a house near the Downs, 12 Beaconsfield Road, which was his home until he removed to London. Here he began the hard work of writing his book on *Electricity and Magnetism*. But there were many interruptions, and he wrote once, "My poor book, when *will* it get finished?"

During all that severe winter of 1880-1 there was great anxiety about his father, whose health was rapidly failing. The family had removed from York, and had gone to live at Castle Hill House, Settle, which had been built by the grandfather Tatham. Silvanus went to them at Christmas, and found the beloved invalid very feeble, and a few weeks later he passed away. Between father and son there had been great confidence and sympathy, and the loss was deeply felt.

On March 30th, 1881, Silvanus Phillips Thompson was married to Jane Smeal Henderson in the old Friends' Meeting House at Glasgow. There was a large gathering of relations and friends, as it was a double wedding of the two eldest daughters. Thompson's mother was not able to be present, so after a week in Perthshire the young couple visited her at Settle on their way southwards to Devonshire.

The first term after his marriage was much occupied by

social engagements, for he was now very popular in Clifton, and his bride was welcomed by his many friends. During the summer parties in the many beautiful old gardens at Clifton and the neighbourhood were greatly enjoyed. This year Thompson acted for the first time as external examiner, an office which he frequently undertook throughout his life, for many different Universities. He was appointed as degree examiner in physics at the Newcastle College of Science, Durham University, and his co-examiner was Professor A. S. Herschel, with whom he for a long time kept up a correspondence on scientific questions. In April 1882 Professor Herschel wrote to him :

“ We may not ask anyone to appraise us for more than two successive years ; it is just on that account that I am charged to write *to you first*, because of the thoroughly approved and appreciated way in which your last year's examination was conducted. I am at any rate very glad to have this task to offer you, as nothing will give me greater pleasure than if you can by any means accept of it ? ”

After spending part of the vacation in Scotland, Professor and Mrs. Thompson went to York to attend the Meeting of the British Association, where they were the guests for the week of the Lord Mayor at the Mansion House. The man chosen, on account of his ability as a speaker, for the office of Lord Mayor that year was John Stephenson Rowntree, a member of the Society of Friends. It was the jubilee year of the Association, and was attended by a most extraordinary number of men of the highest eminence in Science ; some of the dinner and breakfast parties at the Mansion House brought together more illustrious scientific men than have perhaps ever assembled together during an Association meeting since. In the Section Meetings, with Sir William Thomson, Huxley, Darwin and their compeers present and taking part in the proceedings, there were many brilliant and memorable discussions.

Silvanus Thompson read a number of papers in Section A. The third part of his research on *Binaural Audition*, on

Volta Electric Inversion, on the *Opacity of Tourmaline*, and on *A New Polarising Prism*. In the last of these papers Sir William Thomson took a great interest, and said some complimentary things to the author in his usual kindly, encouraging way.

At this meeting the Red Lion Club dinner, which is the opportunity for the scientists to unbend and make fun of their own proceedings, was a very lively occasion, and Thompson did a large amount of the roaring suitable to the younger members. The soirée that year at the Art gallery was a gay function, and the electric incandescent lamps made a novel and brilliant illumination.

The autumn session at Bristol saw the University College under new guidance. Owing to delicate health Professor Marshall had been obliged to resign his position as Principal and go abroad for the winter. He was succeeded by Professor William Ramsay. For some time previously to this Thompson had been acting as secretary to the Educational Board of the College, and this he continued to do. He also now had to devote much time and attention to the fitting up of the new physical laboratories in the Science wings of the College, which were the first portions to be built of the large University which now stands in Tyndall's Park.

CHAPTER V

CONTRIBUTIONS TO ELECTRICAL SCIENCE

THE work to be dealt with in this chapter was for the most part accomplished in the last two decades of the nineteenth century; though a not inconsiderable portion of it belongs to later years. It was all carried on whilst fulfilling successfully his position as Professor, first at Bristol, and then at Finsbury, as described in Chapters III and VII.

The scope and value of his work can perhaps best be grasped by considering it under three headings: (1) Public Lectures and Conferences. (2) Published Works. (3) Discoveries and Inventions.

The headings are taken in this order because it was as an exponent of science that Thompson achieved world-wide fame, and several of his books were based upon his courses of lectures. Through these works his name reached an immense circle of people, to whom he early became known as a scientist of high rank. His researches, though numerous in earlier years, and of value in the gradual progress of knowledge, were none of them of such striking originality or so far reaching in result as to bring him world-wide repute as a discoverer, such as Ramsay, Röntgen, or Madame Curie enjoyed. The biographical note published by the Royal Society mentions the communications recorded in the Society's catalogue of scientific papers as being very numerous, and of them it estimates 166 as important. His technical researches were numerous, and his patents not a few, but none of them were ever worked so as to be remunerative to their author. Chapter VI describes the misfortunes of one of the patents which most nearly fulfilled the desired end of patents, fortune making. The best of such research

work was embodied in his technical books, and communicated to the Institution of Electrical Engineers and to his students.

I. PUBLIC LECTURES AND CONFERENCES

Thompson's public lectures began in Bristol, and extended to Somersetshire and neighbouring counties. When lecturing for the Gilchrist Trust his subjects were by no means limited to the then most popular one of Electricity. At Bridgwater in 1877 only the last of a course of ten lectures on "Recent Discoveries in Natural Philosophy" was devoted to electrical phenomena.

The following list of nineteen titles has been found among his papers of this period, and a choice of two or three of these subjects was frequently offered in response to invitations to give a single lecture of a popular type:

Lectures: The Telephone and Microphone. The Electric Light. The Earth as a Magnet. The Rainbow in Science and Art. The Physical Effects of Heat. The Safety Lamp. Boiling and Bubbling. Waves of Sound. Frost, Ice, and Snow. Comets and Meteors. Artificial Freezing. Atoms and Molecules. William Gilbert, the Founder of Electrical Science. Colour. Optical Illusions. The Photophone. The Eye as an Optical Instrument. The Ear as an Acoustical Instrument. Ancient and Modern Science.

For the illustration of his lectures in Bristol he had easy access to apparatus which was not available farther afield at a cost acceptable to the organisers, and without experiments even his lectures would have been by no means as acceptable to his audiences.

In November 1878 he gave an important lecture on Electric Light in Colston Hall, Bristol, which was so popular that it had to be repeated a week later. That same season, at the end of his Christmas Course on Voltaic Electricity at Bristol Museum and Library, he received a letter from the secretary of the Council sending him his fee and expenses,

“and £20 presented as some acknowledgment of their appreciation of your efforts on their behalf.”

It was in 1880 that he began to lecture farther afield, and gave the opening discourse of the season to the Leeds Philosophical and Literary Society, his subject being “Waves of Sound and the Photophone,” which same lecture he delivered again to a similar society in Liverpool at the Christmas season, persuaded thither by his cousin Isaac Cooke Thompson, who was keenly interested in achieving a success on this occasion.

In the spring of this year, and again in December, he lectured at the Royal Artillery Institution at Woolwich, one of the lectures being on the Electric Light, which was just beginning to be considered a possibility for the immediate future. Invitations came also in that autumn from lecture committees in Burton-on-Trent and Cumberland. This was the winter preceding his wedding. Next year he gave a long course on Astronomy at Bridgwater, and also his little book came out in the late autumn of 1881, so, though he had two invitations from Taunton, and others from York Literary Society and Bootham, he did not undertake occasional lectures away from home, except at the Society of Arts, when before an unusually large assembly he lectured upon “The Storage of Electricity.”

Thompson’s opinion of the importance of his subject may be gathered from the two opening paragraphs :

“Science has of late made two advances the ultimate importance of which it would be difficult to over-estimate. Not many months before he was seized with the mortal illness which robbed us too soon of his rare and unique genius, Professor Clerk Maxwell was asked by a distinguished living man of science what was the greatest scientific discovery of the last twenty-five years. His reply was : ‘That the Gramme machine ¹ is reversible.’ His far-reaching

¹ An early form of dynamo, with a ring armature, which when rotated between the poles of a magnet produced a current of electricity in the wires wound upon it. The reverse action referred to was the sending of an electric current through these wires, whereupon the ring rotated, and the machine became a motor.

and philosophic mind had perceived that in this phenomenon, which to so many had seemed little more than a curious scientific experiment, lay the principle which, if rightly developed, would render possible the electric transmission of power, and, in the solution of this practical problem, bring about social and economic changes the importance of which but few of us have even yet begun to realise.

"If we could to-night summon up the noble spirit of the philosopher, and ask him to tell us what recent scientific discovery came next in importance to this, I think we should receive the reply 'that a voltaic battery is reversible.' The reversibility in the action of the voltaic cell is the counterpart and complement of the reversibility of the Gramme machine; for while the one has solved for us the problem of the *electric transmission of power*, the other has solved for us the problem of the *electric storage of energy*."

Describing storage batteries, he attributed to Gaston Planté of Paris the advance in their practical construction, and described a variety of effects obtained by their use, some of which he himself first saw when visiting the inventor. He showed how these cells and improved accumulators of Faure could be used for producing electric light for domestic purposes, though not economically, exhibiting a selection of incandescent lamps lent to him for the occasion by the Edison, Lane-Fox, Maxim, and Swan firms.

The last part of his discourse particularly aroused the interest of Bristolians, for Thompson discussed the problem of utilising and transmitting the energy derived from wind and water power. Power was not to be obtained just where and when it was wanted. The reversibility of the dynamo-electric machine solved the problem of the where, by giving us a means of electric transmission. He thought the reversibility of the voltaic cell would solve the problem of the when, by enabling us to store the energy whenever it was available. He expressed hesitation in accepting the statements of Sir William Thomson in his recent Presidential Address to the Mathematical and Physical Section of the British Association, as to the use of tidal power not being economically advantageous. He had obtained data from the dock engineer as to the rise and fall of tides, and the

tidal flow at Rownham Ferry, and calculated that a tenth part of the tidal energy in the gorge of the Avon would suffice to light the city of Bristol. He did not consider it impossible of achievement, but looked forward to the development of some different form of accumulator, the types of that day being inadequate for such purpose.

Attempts were afterwards made to use the tidal waters of the Avon, but it was found that so much mud was deposited in the machinery as to render it inefficient.

Work in preparation for these lectures brought Thompson into touch with several people actively engaged in the same problems. He exchanged frequent letters with Gaston Planté of Paris, whom he met at the Congrès des Électriciens in 1881, but who already wrote to him in 1880, thanking him "de votre bonne lettre reçue hier matin. Je vois, avec plaisir, que nous avons les mêmes opinions scientifiques."

Thompson wrote once to his wife expressing delight at the courtesy of many people from whom he obtained the loan of apparatus. From Joseph W. Swan, with whom he at this time began a lifelong friendship, he received a message: "I will send you the lamps with very great pleasure. I am glad that you are experimenting on secondary cells, the subject is of first-rate importance. . . . I spent a very pleasant evening with M. Planté, thanks in a great measure to you."

During the autumn of 1881 the Crystal Palace Company were busy organising an International Exhibition of Electricity, the preparations for which were for many weeks, even before nearing completion, one of the principal attractions to the public. The chief interest was in the numerous systems of lighting by electricity; there was a great display of lights, fed by many dynamos driven by gas or steam engines. Before this time the attempt to light the Savoy Theatre by electric light was the only one generally known to the public in England.

When the exhibits were nearly complete there was a formal inauguration by the Duke and Duchess of Edinburgh, who were received and shown round by the Chairman of the Board, and several others, including Silvanus Thompson,

who was one of the jurors. Early in 1882 he had received a letter from the manager, saying :

"I have just had some conversation with Mr. Preece with reference to some lectures which I wish to organise in connection with the exhibition, and he has shown me your note to him of a few days ago.

"I wish to have a series of four or six elementary lectures on Electricity with special reference to Electric Light. These lectures would be delivered to the general public, and for the most to grown-up people, but who have no electrical knowledge whatever. They should be strictly elementary.

"I shall be glad to hear from you as soon as possible, as I shall not communicate with anybody else on the subject at present."

College Term had already begun, but this was an opening too tempting to be refused, and Thompson replied promptly accepting the invitation, if the arrangements he proposed met with approval. He offered to give four evenings.

The lectures were given in the large concert-room to a numerous audience. They were well reported in many papers all over the country, and thus, with the rapid sale of his *Elementary Lessons*, his reputation as an electrician became fully established throughout England.

The Saturday Review, as is not unusual, passed some caustic comments :

"Professor Thompson showed that he had all the qualities requisite for a high-class popular lecturer—a dramatic style, a clear and audible delivery, and rapidity and dexterity as an experimenter. The lecture was planned on very sound scientific lines, the only fault being that the necessity of covering much ground, and introducing pictures and startling experiments, obliged the lecturer to make very wide gaps in his chain of reasoning, which only fairly good electricians and physicists could fill up. However, a very large audience seemed thoroughly pleased with the lecture. The defects which we have hinted at were unavoidable from the circumstances, and we must really feel glad that so much sound scientific feeling was shown in so very popular a lecture. . . .

"The more astonishing piece of indiscretion to which we

refer was Professor S. P. Thompson's own private theory of electricity. He began well ; he said the " two-fluid " theory would not do ; he said that Professor Clerk Maxwell might have given us a true theory of electricity had he lived : he referred to Maxwell's theories of strain of luminiferous ether in the magnetic field, but he went on to say that he—Professor Silvanus Thompson—went further than Clerk Maxwell, and looked upon a positive charge as a condensation of ether, and on a negative charge as a refraction of ether, and on an electric current as a flow of ether. We dare not say that Professor Thompson is wrong, because we do not profess to know what a charge is, or what a current is, and therefore cannot say with certainty what it is not ; but we fear that this expression will send a shudder through the frames of most physicists who may hear of it. Such a speculation in an ordinary popular lecture we could afford to pass over. But when made in a lecture of such great merit as that lately delivered by Professor Thompson, it becomes of serious importance, and we cannot pass it over without entering our protest against it."

A week later the report was much more favourable :

" It was a model of what a popular lecture ought to be. Professor Thompson had obviously found out and reflected upon the blemishes of his first otherwise excellent discourse, and managed to keep a perfectly logical and easily intelligible train of thought throughout his lecture, and led his hearers on step by step from the first experiments and discoveries of Faraday on magneto-electric induction up to the most modern and improved forms of dynamo-electric machines."

In commenting on the arc light lecture, the writer still seemed to think the young Professor required some of his former prescription :

" At one moment we were able to feel *quel grand homme ! il pense comme nous*, for Professor Silvanus P. Thompson said that what remained to be done in arc lighting was to improve the carbons ; the mechanical control of the arc was now in many systems as perfect as could be hoped for——

" On the question of pure incandescent lamps, we were glad to find that the lecturer, in spite of his obvious bias in favour of Mr. Edison, really gave Mr. Swan fair credit for

his work on the subject. Perhaps Professor Silvanus P. Thompson would do more good to Mr. Edison's reputation if he refrained from such highly coloured laudation."

These comments on and criticisms of Thompson's lectures have been given very fully. He was only just entering into the full publicity of his career, and young, successful, and confident as he was, his essential humility was very possibly not apparent, and the comments deserved. Be that as it may, he preserved the Press-cuttings, and in future reserved his own theories for fuller confirmation.

The Press comments upon these lectures lay emphasis on two points apart from the actual scientific facts and theories. Thompson had taken the opportunity to advocate better education :

"If England desires to reap the benefit of this impending reorganisation of the methods of mechanical production, if she desires that her workmen should rise to the immense future before them, she must not lose an hour in providing them with an education in matters electrical, seeing that a knowledge of electric currents and their properties will be of far more practical importance than a knowledge of any other branch of science. If technical education does not come in any other way, it will be forced upon us by the practical fact that electricity is to be our servant in place of steam and of coal."

Amongst the numerous departments in the exhibition was one devoted to electro-medical appliances, and according to the advertisements of some of the exhibitors, their appliances were likely to effect cures where everything else had failed. In the first of his lectures the magnetic, thermal, and physiological effects of the electric current were illustrated experimentally, with the very emphatic remark that "the mistake of confounding physiological with medical or remedial effects led to the gross impositions of the quacks and rogues who deal in so-called magnetic appliances, and disgrace alike the sciences of electricity and medicine, while knowing nothing of either."

This was incautious action on the part of the lecturer had he desired a life of peace, for he at once received

numerous communications from "medical electricians" and firms manufacturing "magnetic appliances," and also from private people wanting advice.

Thompson took an active interest in preventing these medical swindles, while managing to avoid prosecution for libel. In the celebrated case of the Harness Swindle so thoroughly exposed by the *Pall Mall Gazette* in 1893-4, he was one of the expert witnesses against the "quacks and rogues." *Science Siftings*, a little paper which, with *The Electrical Review*, brought about the exposure, and was one of the journals sued by Harness, devoted a page to the trial of Dr. Tibbits for his testimonial with regard to the virtues of the Harness Belts, and commented thus upon Thompson's part in it :

"Of the value of these belts in generating electricity, which is the point to which counsel for the plaintiff pinned their flag, it will suffice to quote from the evidence of Professor Silvanus Thompson. The learned scientist said that the current he measured from one of the belts was less than could be secured by connecting up an ordinary pin and needle and dipping them in a spot of ink. And, forsooth, five guineas seems to have been the charge imposed upon rich and poor, for a belt possessing no more electrical properties than Professor Thompson alleges can be generated in the connection of what we shall term the proverbial pin and needle. Pointed criticism this, on the part of a skilled witness in more than one sense, and we are sure Professor Thompson possesses a quainter vein of humour than the scientific cult of these days is usually credited with."

It is fair to recall these efforts against quackery, because later, when Thompson was helping to organise the Spectacle Makers Company's Examinations for Opticians, and encouraging the granting of certificates, he met with some heated opposition from sections of the medical profession, especially from ophthalmic surgeons, who suspected his policy as encouraging unskilful and fraudulent practice.

In 1882 Thompson had already, in the January vacation, lectured in Oldham, Birmingham, and Altrincham, but after the Crystal Palace Lectures, invitations poured in from all sides, from Falmouth in the South-West, to Don-

caster and Newcastle in the North, from Lecture Committees and Societies, Institutes, Y.M.C.A.s, Mutual Improvement Societies, and from several groups of Quakers. By September he wrote to one institute, saying his spare time was "full up to Easter 1883," and in response to a local invitation, that he had "already refused twenty invitations this season, all energies wanted for our own laboratories."

• Perhaps something should be said about his welcome in the North. At the end of the year he lectured again in Liverpool at the United Soirée of the Literary Scientific and Art Societies, his subject being "The Economic Production of Electricity." O. J. Lodge was now settled in his home there, and invited Silvanus and his wife to stay with them, if they could be spared from over the road, at the cousins'. After Christmas he made a tour, lecturing on "The Electric Light" in Settle; it was a great event in that quiet little place. He went on to Glasgow, speaking there on "The Earth a Great Magnet," a lecture already delivered in the Midlands. The Glasgow people were enthusiastic about his lecture. To his wife, who was not able to accompany him, he wrote home :

•
"GLENVAL, POLLOKSHIELDS,
January 12th, 1883.

"All went off well last night. Sir William Thomson was present, and moved the vote of thanks at the end. The people here say I gave them the best science lecture they (The Glasgow Science Lecture Association) have had this season. . . . Papa and I are going to lunch with Sir William."

This lecture had also been very well received and reported in Altrincham, where great local enthusiasm was displayed by the Bowdon Literary and Scientific Club, by whose efforts he was able to make use of "a lantern of peculiar construction,¹ which allowed of experiments being readily performed in it, and thus exhibited on the screen. Experi-

• ¹ This is probably the lantern described in *The Photographic News* of December 8th, 1882, as used by him at his Society of Arts Lectures on *Dynamo-Electric Machines*.

ments were, in consequence, possible which would otherwise have required heavy and costly apparatus to render them visible to a large audience. . . . For nearly two hours he was listened to by his audience with an attention that never flagged."

His second lecture in Altrincham, less than twelve months after his first, was an even greater success, when, owing to the enthusiasm of a local man, electric plant was obtained for the occasion, enabling the inhabitants to enjoy for the first time the dazzling light of four arc lamps, while the lecturer discoursed of their mysteries, and the history of their invention. His concluding remarks turned on the advantages and disadvantages and the economic production and distribution of electricity, comparing its cost with that of gas. He told how in France it had been proved possible to plough, to reap, to sow by means of electric engines. He believed he had proved in various ways that there would be distinct economy in generating currents of electricity at a central station on a large scale, and in distributing them to electric engines, which would supply power on a small scale far more cheaply than steam engines.

It is interesting to note that in these early days, before electricity had begun to be adopted by the community for practical purposes, Thompson always seems to have pictured large central stations. Frequently in later life he deplored the immense number of small stations and companies; and the idea of organising about a score of central stations for the whole of Great Britain, recently so prominently before the public, had his support over twenty years before it was a popular question. The subject of central stations evoked general interest at the Bradford Meeting of the British Association in 1900. It arose in the Section of Economics and Statistics in a discussion on Municipal Trading, during which Thompson remarked that the supply of electricity for lighting and power on a large scale was not a parochial or even a municipal question, but a large question affecting whole counties and districts; and he commended the Lancashire Powers Bill, and urged wide co-operation in the matter of electrical supply.

Advocates of municipal administration were not pleased by this. A leading article in *The Yorkshire Post* next morning rejoiced that, "in spite of Professor Silvanus Thompson," bills for electrical supply were actually being promoted by local bodies, such as the London County Council, and the Corporations of Glasgow, Manchester, and other cities. Thompson favoured the schemes of "various profit-earning companies" that by the Electric Power Bill sought to disturb the rights of the local corporations in order to establish their stations and installations. He had given expert evidence before Parliament in 1900 in connection with the Lancashire Power Bill; it, with several others, was defeated. The following year, after visiting the district proposed to be served by the Caledonian Electric Power Scheme, he reported favourably thereon to the promoters; and also gave evidence to the Parliamentary Select Committee in favour of both the Yorkshire and the Derby and Notts Electric Power Bills. In his evidence he declared himself to have been for fifteen years an advocate of extensive schemes of this sort, and he described results obtained from such all over the world.

He was full of this subject, and when invited to deliver the Popular Saturday Evening Lecture at the British Association at Bradford, he chose as his title "Electricity and Industry." The main interest centred round the question of the supply of electricity "in bulk," and he described the great power stations of Niagara, of Rheinfelden, and of Vizzola in Lombardy, which were creating whole new industries, and new industrial communities living under conditions materially and socially greatly in advance of those with which they competed. England, not possessing waterfalls,¹ should place electric generating centres right at the mouth of the coal-pits. He urged upon his audience the thought that this was not only an industrial question; it affected the well-being of the community at large; it was a great national question.

This lecture was delivered in the St. George's Hall,

¹ Later Thompson took a great interest in the use of water-power at Aberystwith.

which was said to seat 3,500 persons, and was described as being packed from floor to ceiling with an audience composed in an overwhelming proportion of men of the working classes. According to the report in *The Times* :

“They listened with the closest attention and keenest interest to the lecture, which lasted for an hour and three-quarters, and showed their appreciation of the many effective experiments and demonstrations in the most cordial way. At the conclusion of the lecture, and again when the vote of thanks was put by the President, the manifestation of feeling was such as is generally associated with a great political meeting, rather than with a scientific lecture.”

Thompson wrote to his wife :

“The meeting has been very successful. They pressed me to repeat my lecture for the Bradford children for next Saturday evening. I declined : but have agreed to give them a Children’s Lecture on December 31st. ‘Mr. and Mrs. Priestley [the Mayor and Mayoress, with whom Thompson stayed in Bradford during the Association] hope that you will come down to Bradford then ; and, in fact, I have also had invitations to stay on that occasion from two other quarters—[Quakers]. Nothing could have exceeded the kindness of Mr. and Mrs. P. ; and all the Bradford folk have been most cordial. I find on coming back a most enormous pile of letters and of College work. How to get through the next two days I know not : it will be a great push.

“We had a lively dinner of the Red Lions on Tuesday night. My host was amongst the privileged few who were admitted (of local men), and greatly appreciated the burlesque science. I drew them some caricatures on the blackboard as a small contribution.”

The experiment of a lecture to 3,000 children at once, even though only picked members of the upper standards formed the audience, was disappointing. The children wore clogs, and were so excited by the novelty of the occasion, that even the appeals of the Mayor failed to keep them in their seats, and the lecturer found it almost impossible to make his voice heard above the clatter. However, there

were many who were quite satisfied that the imagination of the youngsters was aroused by the brilliant experiments on "Electricity at Work."

In tracing Thompson's interest in the subject of central supplies of electricity, we have been carried on far into "The Electrical Age," and must return to Bristol, 1882.

At the opening of the University Session in the autumn, Thompson gave the introductory lecture on a Saturday evening in the Museum and Library, where many of his colleagues, and a large assembly besides the students, attended to hear his discourse upon "The Age of Electricity." He gave an epitome of the advances of the science which had been so marked in the six years that he had been at Bristol, and he appealed to the citizens not to be indifferent to the advancement of electrical science and its applications to the machinery of life, concluding with a well-prepared peroration as was his wont :

"I have insisted on the reality of the age of electricity on which we are entering, as marking a distinct epoch in the material civilisation and development of the human race. Far be it from me to depreciate the other factors in the development of man, and of these intellectual faculties, whose roots are struck, not in the material conquest of the forces of nature only, but in those moral and spiritual forces which, though less tangible, are none the less real. Where scientific knowledge ends, there begin the emotional and poetic faculties, the play of purely intellectual activities of which science can render no account. Those faculties can exist without science—nay, may be said to have pre-existed. Science did not make them, and cannot destroy them. Yet no man possessing these faculties can be heedless of scientific progress, for, after all, the sober facts of science are amongst the things that most excite the wonder, the amazement, the delight, the poetic fervour of man."

This chapter was to be mainly devoted to Thompson's work on "the sober facts of science," but it was so characteristic of his mind to link these with the imaginative elements of human nature, that it seems unnatural to pass by without this slight reference. The fuller working out

of this thought was expressed publicly in an address which he gave in 1885 as President of the Wellington Literary and Scientific Institute.

In 1882 Electric Light was *the* question of the day ; it was passing out of the region of theoretical experiment into that of practical utilisation. The gas companies began to take alarm, and there were many heartburnings in the various municipalities as schemes for the new lighting were proposed and opposed. Citizens of Bath, who were eager for reformation, engaged Thompson to give a lecture in the Theatre Royal, and provided him with funds for the hire of the necessary machinery for exhibiting both arc and incandescent lamps in action.

Thompson took every opportunity of furthering the popularity of the new light, and contributed to a variety of journals, articles intended to reassure the public as to its cheapness as well as its other advantages.

1882 was the year of the Electric Lighting Act. In this measure Thompson had some part, having prepared a Report and General Advice on Draft Provisional Orders. This Act was described in 1884 as "a panic Act," carried through by representations that the public would be left at the mercy of an enormous monopoly. It not only fixed the maximum rates of charge to consumers, but contained an objectionable Purchase Option Clause, authorising local authorities, if they so chose, to acquire, after twenty-one years, the entire property, plant, etc., of the company or person who had undertaken to supply electric light, at their then value, without any addition in respect of compulsory purchase, or of prospective profits. It was felt, and publicly expressed by Sir Frederick Bramwell at the British Association in 1884, that the conditions imposed by the Board of Trade framing of the Provisional Orders had been unjust, and had discouraged the investment of capital in such enterprises ; and herein lay the reply to the frequently heard question : " Why does not electric lighting go ahead ? "

Thompson was amongst the forty-five members, but not one of the eleven on the Executive, of the General Com-

mittee, formed on the suggestion of the President of the Board of Trade, to frame clauses in amendment of the Electric Lighting Act, and to confer with the Board of Trade as to the terms of the Provisional Orders and Licences. It was summoned in November 1884, and the deliberations continued intermittently for some months.

1882 was also the year of the Lightning-rod Conference, which drew up rules for the guidance of those who desired to protect their property from being struck. The findings of this Conference have since been much criticised, particularly by O. J. Lodge, but also by the Lightning Research Committee (1905). Thompson's contribution to this subject was in the form of a paper to the Physical Society, published in the *Philosophical Magazine*, March 1888, "On the Price of the Factor of Safety in the Materials for Lightning-rods." In proportion to their effectiveness iron was, he calculated, very much cheaper than copper.

Another question of public interest in which Thompson took an active part from early years was that of safety in the coal-mines. In 1884 the Ellis Lever Prize was offered for a perfect safety lamp. The Miners' National Union laid down the conditions, and Thompson served for them as one of the adjudicators, receiving very cordial thanks for readily undertaking the arduous duty of testing the safety lamps, and also for the admirable and painstaking manner in which he had carried out the duties at the cost of much of his valuable time involved in travelling, as well as in experiment and consultation with others. Three years later, when a lamentable disaster in the Udston colliery was reported as caused probably by the opening of a lamp by a miner, he wrote to *The Times*, pointing out how no perfect lamp had been found amongst those submitted for the prize in 1884, but that since then the electric safety lamps had been much improved. He suggested that a Royal Commission to supplement the work of the Accidents in Mines Commission should institute a special inquiry into electric safety lamps.

Thompson once spoke to an audience composed chiefly of miners, when in 1891 he gave the British Association's

operatives' lecture at Cardiff, on the subject of "Electricity in Mining." A crowd of men attended, special trains having been run to bring them to it ; this in spite of the fears of the local committee, who were for giving up the whole idea within a week or two of the lecture, when most of his preparations for it were well on their way ; and such preparations were no light task to anyone who, in the words of Sir Frederick Bramwell, "was willing to devote himself on behalf of the Association." Machinery he then described as in use in some parts of the world, has not yet been made use of in English mines, as he had hoped it might be.

After he left Bristol and became more closely occupied with the innumerable calls upon his time in London, Thompson gave up the practice of delivering isolated popular lectures, except on rare occasions. He lectured several times in the London Institution, and in 1889, when invited to lecture there, he drew up the following list of subjects : The Magic of Amber and Lodestone. Distribution of Electricity. Electric City Lighting. The Galvanic Arts. Arcs and Sparks. Action and Reaction. Sins of Art against Science. Myths of the Magnet.

Amongst his correspondents at this period was Mr. James Wimshurst, F.R.S., Chief Shipwright Surveyor of the Board of Trade, who devoted most of his leisure time to experimental work, and fitted up for himself at his house large workshops, equipped with engineering appliances, driven by power. Thompson experienced the pleasures of his generosity and hospitality, to which he paid tribute in an obituary notice for the Royal Society in 1903. In 1881 Wimshurst had become interested in electrical influence machines, of which he constructed more than ninety, making continual alterations and improvements. Many of them he presented to his scientific friends ; Thompson received two at least at different times, once with the note :

"and please remember that at all times I shall be glad to contribute any other thing I may be able to aid you in your advancing steps of research—moreover, I am (except for

business calls) usually at home in the evenings, and shall always be pleased to see you for the little chat, or a few experiments."

1888 saw the 100th anniversary of influence machines, William Nicholson having written a letter, read to the Royal Society by its President, Sir Joseph Banks, in 1788, announcing his invention of a "revolving doubler, an instrument which, by the turning of a winch, produces the two states of electricity without friction or communication with the earth." Thompson wrote a short history of the after-development of Nicholson's doubler, which was published in the *Journal of the Proceedings of the Society of Telegraph Engineers and Electricians*; and at his instance Wimshurst was persuaded to lecture at the Royal Institution on "Influence Machines." Three years later Wimshurst wrote to Thompson regretting the little attention being given to that line of research:

"neglected for the reason (at least so I suppose) that there is no money in it, and the branches of electricity which for the present have commercial value are flooded with seekers. Now, I know that you do take an interest in the glass and tin foil line as much as in the copper wire, and the modern bricks of iron business, and therefore, if you should have another evening to spare in the course of this recess, I assure you that I think we might profit by it together."

Their interest was not confined to the elder man's "fadism," as he dubbed it, for in 1894 he wrote to Thompson:

"Your beautiful experiment of the Electrical Vortex¹ has been in mind since. I did not try the twisting force of the egg, but it seems to me that it would be sufficient to

¹ At a Royal Society soirée Thompson exhibited nine Illustrations of Polyphase Electric Currents, one of which is described thus in the programme: "Revolution of a copper egg in a rotatory magnetic field." The eggs lay upon a tray, and when the electromagnets in the neighbourhood were excited they began slowly to rotate upon their sides, but as their speed increased they rose and span upon their ends. The experiments aroused great curiosity and delight. They were also exhibited at "Morland" on the occasion of one of the evening "At Homes" of the family.

drive an aerial machine. Could you not make a light egg or sphere, and on it place light vanes ; or have the light vanes with just sufficient metal on them to suit your purpose, if so it would poise itself in the vortex, and add another to your instructive and beautiful devices."

In the year of Queen Victoria's Diamond Jubilee, Thompson lectured at the Crystal Palace on "Electrical Discoveries and Inventions during the Queen's Reign," including in his demonstrations signalling across space, not through conductors, the beginnings of so-called "wireless telegraphy." Of this subject he became an accredited exponent, though claiming little contribution to its progress ; he followed closely the developments from the outset, which he dated from about the year 1876, when he was himself experimenting on oscillating sparks and their inductive properties (see p. 22).

In 1898 he received from the Society of Arts one of their silver medals for his lecture before them on "Telegraphy across Space." ¹ In his lecture he described the achievements of Preece in the Bristol Channel and elsewhere, using the conductive method of signalling through water between long base-lines on land. Effects obtained by earth conduction had been investigated to some extent, and induction methods also were under experiment by Preece, who had used the telegraph wires forty miles apart on the Scottish border, and had communicated sounds from the Newcastle-Jedburg line to the Gretna line. Thompson told of a vain offer he had made to a financial friend in the city seriously to undertake to establish telegraphic communication with the Cape, provided £10,000 were forthcoming to establish the necessary basal circuits in the two countries, and the instruments for creating the currents. Two effects coupled in his mind led him to believe in the possibility of his plans : Firstly, when one of the dynamos of the Ferranti station at Deptford became once accidentally earthed, all the railway signal telegraphs of South London were affected, and the earth currents were detected as far away as Leicester, and Paris. Secondly, a single circuit operating an instru-

¹ Published in the Smithsonian Report for 1898, Washington, U.S.A.

ment such as the phonopore by means of alternating currents of high frequency could be heard in telegraph lines a hundred miles away.

In his lecture Thompson spoke of the great importance of Lodge's idea of "syntony," the tuning of the transmitting and receiving circuits, so as to enable the receiver by resonance to select out one particular signal from amongst many issued simultaneously from different sources. The greatest practical successes till then achieved were those of Marconi, who for two years had had the advantage of facilities for experiments on a large scale granted to him by the British telegraph department, and had signalled intelligibly over a distance of eleven miles; and of Professor Slaby, of Charlottenburg, who had penetrated thirteen and a half miles over land; many experimenters were then at work, and making rapid progress in other countries and continents, and no account Thompson could give of the work could be complete. •

Writing to Lodge about *The Times* report of this lecture, Thompson added a postscript:

"After my lecture a man came up to me. Said he had heard a lecture on Marconi last week by a lecturer who had Marconi's own apparatus to show, who told them that M. did not use electromagnetic or Hertz waves: for EM. waves spread like sound in all directions (diagram on screen), while the Marconi waves went straight to the place to which they were directed—even through mountains—(diagram shown)!!!! I replied it was most amazing."

Many ill-informed people seemed to be under the delusion that "Marconi waves," as distinct from Hertz waves, had a real existence and had special properties. This, of course, is nonsense.

Thompson lectured some years later to the Hampstead Scientific Society, using Lodge's apparatus.

The development of wireless telegraphy in England is not a happy story. The name of Marconi calls up a whole series of newspaper controversies, patent cases in the law courts, as well as libel suits involving the names of members of the Government.

It was as a historian of science that Thompson became involved in these distasteful affairs. In April 1902, after Marconi had achieved the magnificent success of sending an intelligible signal over 1,500 miles across the Atlantic, Thompson contributed to *The Saturday Review*, for which journal he from time to time wrote on scientific subjects (though nothing could have been more alien to his sympathies than the political views of the paper), a signed article entitled "The Inventor of Wireless Telegraphy." This article was a fierce attack upon what Thompson considered the excessive claims of Marconi to the inventions of the day; and it set out the case of the experimenter whom Thompson believed to be the original inventor of wireless telegraphy, Oliver Lodge, whose experiments had been exhibited and explained to many scientific societies in England two years before any patents were taken out by anyone.

Thompson held a very poor opinion of English Patent Law, and gave his reasons for it in his second Presidential Address to the Physical Society in 1902. Such was English Law, that Lodge, having expounded his inventions to scientific societies, might not patent them in England, though he might, and did do so in the United States, at the Patent Office where rigorous proof is required as to actual first invention by the would-be patentee.

The article in *The Saturday Review* provoked a hostile reply from Marconi, and a rejoinder from Thompson, very explicit, as he took the trouble to "make good, point by point, by reference to the pages of original documents," the statements to which he put his signature; statements to which no detailed reply was forthcoming, only the suggestion that he was retailing malicious gossip, and had fallen into "absolute and gratuitous untruth." In vain he asked for contradiction of his facts. Correspondence was afterwards opened in *The Times* and the *Westminster Gazette* by a letter from Lieutenant Solari of the Italian Navy, who claimed a friendly interest in Marconi's experiments; and finally the controversy was turned to a complete comedy by the intrusion of Mr. J. Henniker Heaton, M.P.

As was said by a writer in *Electrical Investments* at the time, whether Professor Thompson were right or wrong in his history, the general public will always associate the name of Marconi with wireless telegraphy; "commercial success is, in fact, the proper criterion in this as in most matters of applied science." In fairness to Thompson, however, it must be added that a month or two later the same newspaper contained the following paragraphs:

"The electrical Press is calling on Mr. Marconi for an explanation. The cause of the clamour is the following 'application for amendment' in a recent issue of the Official Journal of the Patent Office:

"18,105. Guglielmo Marconi seeks leave to amend the Application for Letters Patent, numbered as above, for "Improvements in coherers or detectors for electric waves," by converting it into an application for a Patent for an invention communicated to him from abroad by the Marquis Luigi Solari, of Italy."

"Those who have followed Professor Silvanus Thompson's vigorous onslaughts against Mr. Marconi's priority in certain patents will appreciate the desire for an explanation."

Controversy on the subject never died down for long, but Thompson took little further part, though following every achievement in the scientific field, and, as far as the public were permitted to do so, the schemes and rivalries of the company promoters. In 1906, at the time of the second International Wireless Congress at Berlin, there was a great stir in the Press, when it seemed that the contracts of Great Britain and Italy with the Marconi companies prevented these Powers from agreeing to the internationalisation of wireless telegraphy. Garbled history in defence of certain actions of the Marconi company was put forth in *The Times* correspondence columns, and provoked Thompson once more to endeavour to correct the impressions of the public in this matter.

He presented a concise history of the subject in a pamphlet privately printed in 1911 in connection with the successful petition of the Lodge-Muirhead Wireless and General Telegraphy Syndicate, Limited, for the renewal of Lodge's patent of 1897 for Improvements in Syntonised Telegraphy with-

out Line Wires. In pronouncing his decision, the judge remarked that the patent was a great advance upon the Marconi patent of 1896, and that the patentee had been inadequately remunerated, partly because the owners had been seriously hampered by the Post Office monopoly, which prevented them from obtaining the licence necessary for working the system in this country.

Lodge wrote to Thompson :

" March 11th, 1911.

" MY DEAR S. P. T.,

" I have just read the proof that you sent me on Points in Early History. It is an extraordinarily able production, bringing out the essential features with great skill and knowledge. I could not have done it nearly so well. You certainly have a genius for matters of scientific history, and I am grateful to you for your help."

When the pamphlet was complete he wrote :

" The case you make out is impressive, and the amount of trouble you have taken over it is extraordinary, not to speak of the great ability it displays. I should think that some day it ought to be published. My own statement too might be published, but yours is the more valuable as being independent of what people will suppose to be bias caused by personal interest."

There remain to be mentioned one or two other public lectures of some importance. At the Meeting of the British Association at Ipswich in 1895, Thompson delivered one of the two evening lectures to the members. The subject was "Magnetism in Rotation," a study of the elaborate development of polyphase machinery, from Arago's casual observation in 1822 of the deadening effect of a copper plate placed near a vibrating magnet, and Faraday's work on eddy currents induced by a revolving magnet. In the light of modern knowledge he discussed the origin of terrestrial magnetism and auroral phenomena. The magic of magnetism had great fascination for him. It formed the subject of many of his lectures, the Boyle Lecture at Oxford, the three Tyndall Lectures at the Royal Institution in 1907, and one in the same year at Bristol when he went back to

his old haunts to inaugurate a course of popular lectures at University College. Two of his Friday Evening Discourses at the Royal Institution were devoted to this subject, the first, on "Magnetism in Transitu," was illustrated by a cinematograph film taken from a long series of careful diagrams drawn by hand to show the movements of magnetic lines of force. His last Discourse before the war, in May 1913, was on "The Secret of the Permanent Magnet"; a very excellent title, for the secret was not to be disclosed in his day and generation, though he worked hard to lay it bare.

Of his courses of public lectures on electrical subjects, by far the most important were his Cantor Lectures of 1882 on "Dynamo-Electric Machinery," and of 1890 on "The Electromagnet." Both of these were published, and afterwards were expanded into substantial volumes. The lectures were very much appreciated by the limited audiences that were able to attend them, but their significance is small compared with that of the books which are living yet.

II. PUBLICATIONS

In October 1879 Thompson sent to Mr. Norman Lockyer, for insertion in *Nature*, some notes on physical subjects which met with cordial approval, and he was invited to undertake "a Physical Column, on somewhat the same lines as our astronomical column and meteorological notes," to begin in the new volume, when *Nature* entered upon the second decade of its existence. He had already undertaken some reviews for the journal, and his capabilities as a writer were therefore not unknown to the editor. He was to compile the column from material supplied to him by the office, and from excerpts from Poggendorff's "Annalen" and other foreign serials. This column was not continued for more than about a year, but Thompson was for several years a frequent contributor of articles. Amongst these were some on "Physics without Apparatus," which it was at one time suggested by the publishers might suitably be collected into a volume for "The Nature Series," but the suggestion was never carried out.

The first book Thompson undertook to write was also

never completed. He thought that there was a need in England for a book equivalent to Müller-Pouillet's French "Textbook of Physics," and he had a great desire to publish some such student's manual.

Independently he approached Messrs. Macmillan & Co. on the subject, at the same time offering to lay before them another proposal respecting an Elementary Treatise on Electricity and Magnetism for their School Class Book Series. The publishers expressed themselves frankly unwilling to take the venture of the bigger book, for, though they heard favourable expectations as to his future from all they consulted, they were not yet able to regard him as *certain* to turn out what would be a standard textbook of the subject. They were, however, willing to entertain the idea of the smaller work on electricity and magnetism, and Thompson set to work diligently upon his congenial task. At the time of his marriage in March 1881 he had completed the writing, and was busy with the proof correcting, a task with which his wife was able to assist him, having had training in it from her father, whom she had helped in connection with his writings on economic subjects.

By the end of January 1882, when the book had barely been out two months, and neither the educational nor the scientific and technical journals had yet published reviews, the publisher wrote to tell him that he should be preparing necessary alterations in case of a reprint, although, "of course, we cannot expect the sale to go on at the same rate." This anticipation was quite wrong. The book was reprinted twice in 1882, and altogether sixteen times in the twelve succeeding years. It met with an immediate appreciation from many of his scientific friends. Almost the very day that he received his copy, Oliver Lodge sent a postcard :

"November 9th, 1881.

"The [anti-] vivisectionists will be down upon you; see p. 23.¹ I have written to inform. It will be my textbook henceforth."

¹ R. 23 bore "the delightful picture of the Italian gentleman with wavy hair, taper fingers, and a three-legged and be-tailed cat-skin, presiding over an electrophorus."

In February following he wrote at greater length :

"DEAR THOMPSON,

"I am delighted to hear of the success of your book, *Floreat silva* ! I wish I could get through an edition in a few months. I have been thinking I should like to review it some time. I could send a notice to *The Electrician* any time, but I daresay you would prefer *Nature*.

"I have not noticed much to correct. I have not read it yet, but only glanced at it. Several points I have noticed which I liked much. Page 200 (bottom) : I don't think you should even suggest that this is a paradox. Potential and surface density do not pretend to be connected.

Density $\propto \frac{dV}{dn}$, not V .

"I don't think I have noticed a thing else.

"I was asked just lately to write an elementary Electricity, but I told the people it was too late, and that I couldn't hope to beat your book (nor indeed to equal it). I would write a big book for them if they liked, but in elementary books yours had the field to itself.

"I am fearfully busy just now, as you may judge from enclosed prospectus [Liverpool, University College]. Please send me one of yours.

"With kind regards, yours sincerely,

"O. J. LODGE."

"I recognise your handwriting in *Engineering*. . . . I am not very satisfied with my latest test-tube Daniells.¹ They work well when first set up, but the glass gets dry after. You must not depend on the conduction of a film of moisture on glass."

It was the compactness of the volume that was perhaps its greatest achievement. Professor Rücker wrote to him, "You have certainly succeeded remarkably in being at once concise and clear"; and Professor Frankland, "Such a class book was much wanted; you seem to have made it clear, concise, and practical, and I predict for it a large sale." From the business men also he received tribute. Joseph W. Swan wrote :

"I have only had time to glance through it, but it is only necessary to do so in order to see that it fills a place in

¹ See p. 137.

science literature till now almost vacant, and much needing to be filled. I have often been asked if such a thing existed, and had to answer 'No.' You have the art of clear exposition, and one has only to read the first paragraph of your book to realise what a pleasure it must be to learn lessons with you for teacher."

Professor Carey Foster wrote :

"I like the book very much indeed. You have managed to bring it up to a much higher level than anything of the same kind existing hitherto, and I doubt not it will be recognised as *the* book on the subject."

It did virtually become *the* book. How completely this is true may be gathered from the reviews of the last edition in 1914. For instance, *The Electrician* wrote :

"This volume is a new edition of a book that needs no recommendation. The book is probably more widely used than any other on the subject, and is, beyond question, well known to most of our readers. The first edition was published nearly thirty-five years ago, and after being reprinted eighteen times, a new edition appeared in 1895. This edition was reprinted no less than twenty-one times.

"We venture to think that the book owes much of its popularity to the fact that the author is an experienced teacher. As such he is able to present the several branches of the subject in logical sequence, and to give the exact amount of information required by a beginner. The latter will not regard his education as complete when he has finished reading 'Thompson,' but being *properly grounded* he will be able to turn to more ambitious works. For this reason *Elementary Lessons in Electricity and Magnetism* may be regarded more as an institution than as a mere book."

The early reviews were unanimous as to the usefulness, attractiveness, and reliability of the little volume. Thompson was rather disappointed that the scientific papers were so slow in noticing it at any length.

However, in April the review appeared in *Nature* signed O. J. L. Whilst ending with a strong recommendation, to teachers to adopt it at once as their textbook, the comments passed were throughout in different style from

those of all the other reviews ; some of the most enlightening are quoted :

“ The historical statements indicate by little additional details that they have not been simply copied from the joint-stock property of textbook writers, but that some original authorities have been referred to. The author's statements of the well-worn facts are moreover interspersed with notes and characteristic touches which redeem them from dulness.

“ If it is necessary to say anything by way of general criticism, it is that the author sometimes shows a disposition to theorise a little too baldly, and to state without qualification, and with an air of certainty and completeness, views concerning the nature of electricity, which though undoubtedly they have some truth in them, *i.e.* which certainly are steps towards the truth, yet have no finality about them, and which require to be cautiously worded and expressed lest they should mislead. For instance, his statements in the preface that ‘ electricity is not *two* but *one* ’ ; that, ‘ whatever it is, it is not *matter* and not *energy*, ’ that ‘ it may be heaped up in some places and will do work in returning to its former level distribution, ’ are all, considered strictly, unjustifiable dogmas of the kind we have mentioned.

“ Neither are we altogether disposed to approve of the phrase ‘ conservation of electricity, ’ by which the author seems to set much store.

“ However, all these doctrines are immense improvements on the old forms of the fluid theory, and, being steps towards truth, will probably do far more good than harm. We are fully impressed with the necessity in teaching of getting *some* ideas into the heads of the students to begin with, and of polishing them up as much as possible afterwards.

“ On the whole, then, while we have not been able to find any statement which is certainly and distinctly wrong, we find a very great deal which is not only certainly and distinctly right, but which is also exactly that concerning which a real student desires, but has hitherto been unable to obtain, information.”

His friend Professor G. F. FitzGerald of Dublin wrote to him concerning the method of teaching referred to by

Lodge in this review. He had seen the proofs of the book at the British Association at York in the summer, and found that the complete volume quite came up to the high expectations he had formed :

“ I am particularly pleased with your idea of giving three elementary all-round chapters to begin with, and am thinking of arranging my lectures next term on that principle, at least as an experiment to see how it works, as I presume you cannot patent an idea of that kind.”

The phrase “ conservation of electricity ” by which the author “ set much store ” was the outcome of a considerable amount of reading and thought. Just when his book was in the press, Thompson was made acquainted with some work of Monsieur G. Lippmann of Paris, published in *Comptes Rendus*. In his preface Thompson had claimed to be the first to enunciate the doctrine under this title, but after seeing this earlier paper he appended a footnote referring to the prior publication of Lippmann’s “ elegant analytical statement ” of the same view, independently reached.

As the practical applications of electricity began to be realised, interest in theories as to its nature was revived. Thompson was roused to speculations initially by gaining close familiarity with Clerk Maxwell’s theory, and by the hope of establishing the true nature of electricity by experiment. Accepting the idea of the universal presence of electricity, electrification being a state of possession of too much or too little of the “ imponderable fluid ” electricity, he tabulated all the facts available from published accounts of experiments which threw any light on the question as to whether the vitreous or the resinous, the so-called positive and negative electrifications of Franklin, were the true excess. In particular, analogies with the theories of radiation led him to state, with some degree of conviction, that “ the state of resinous (negative) electrification corresponds in reality to that of excess, or to a true plus electrification.” These speculations he expounded fully in a paper on “ The Conservation of Electricity and the Absolute Scale of

Potential," which he submitted to the Royal Society. Dr. Spottiswoode conferred with Professor Stokes on the merits of the paper, and reported that, notwithstanding the interest which attached to his views of the subject, the paper was of a more speculative character than such as were usually published in the Proceedings, and recommended it as more suited to the *Philosophical Magazine*, where in due time it appeared.

When the book was largely rewritten in 1894, the preface containing these theories disappeared, and a short paragraph on the contemporary position as to theory was inserted in the text, the new preface being devoted to outlining the chief developments in theory and practice which the thirteen years had witnessed. When twenty years later the work was completely revised for a second time, it was, again the latter half of the book, dealing with the industrial applications of electricity, that required remodelling, though throughout the work the modern conception of *electrons* as the substance of electricity was borne in mind. Thompson's second daughter, Helen, who as a Newnham student had studied Physics at the Cavendish Laboratory, rendered him some assistance with this part of the work. The review in *Nature* refers to the chapter on Electrons as a welcome addition, the author having managed to "compress into a dozen pages as much information on this subject as is usually contained in books of much larger size." In this he had previously achieved mastery, having contributed articles on Electricity to *Harmsworth's Self-Educator*, and having dealt in one short weekly section with "The Nature of Electricity."

His 1914 volume brought him a tribute from his former student and secretary, who had done much to help him with the former revision, Miles Walker, now a Professor at the University of Manchester:

"This book will always be to me the authority for first principles. The simple figures have formed in the mind, images which stand for the laws they illustrate. With thousands of readers it must be the same long after they have passed on to other books. The fascination which lies in the

study of natural laws has been caught by you, and caged in these pages, so that as one turns them over it peeps out and lures fresh readers to give their lives to things electrical. I wonder how many engineers you have won already. There will be many, many more in the future, and the new chapters will add to the spell."

Those who fell under the spell of the book were not Englishmen only. From the beginning it was largely bought in America ; from France, Germany, Italy, Sweden, Poland, Spain, and Japan, came letters from those anxious to obtain permission to translate the book, so that others in those countries might benefit.

The Cantor Lectures mentioned above (p. 85), and in addition those on Arc Lamps of a later day, were published in full by the Society of Arts. After the lectures on Dynamo-Electric Machinery, Thompson received in January 1883 the following, in a letter from Mr. W. M. Mordey (later President of the Institution of Electrical Engineers) :

"DEAR SIR,

"Your Cantor Lectures were a decided boon, and to have them in full and well illustrated as they appear in the Society's *Journal* is a great treat. Everywhere I hear them spoken of as what was wanted on the subject, and as the perfection of 'plain, unvarnished' explanation. After the thick coats of 'varnish' so painfully familiar to young 'searchers after truth' like myself, I assure you we appreciate your straightforward work. . . .

"I have some further results springing from your suggestions, and hope to send you an account soon. I believe I shall have an opportunity of getting curves of Edison and several other machines shortly."

This letter shows the sort of impression Thompson produced on men in the electrical industry the first time he came up to London to lecture to them. Professor John Perry, writing about some machinery in which he had an interest, added : "Let me congratulate you on the immense

amount of information you have been able to put into your lectures"; and he, like others, took for granted that they would be published in compact form.

The reprint very rapidly reached a distant public. Spare copies were in request on the Continent; an American reprint, with slight additions, was produced unauthorised; and from Paris came the following letter in July 1883:

"MONSIEUR,

"Attaché à la Maison Siemens frères de Paris, j'écris dans quelques journaux scientifiques et publie en ce moment dans l'un d'eux la Traduction de votre remarquable travail 'On Dynamo-Electric Machinery' (Cantor Lectures). J'aurais peut-être l'intention de faire de cette traduction une Brochure séparée, et viens vous en demander l'autorisation.

"Je vous serais reconnaissant, monsieur, de vouloir bien m'honneur d'une réponse, et vous prie d'agréer la respectueuse expression de mon entier dévouement.

"ÉMIL BOISTEL."

Thus introduced himself the Frenchman who translated all Thompson's works on Electricity, and was henceforth in constant correspondence with him. After their first meeting he was always hoping for an occasion which should bring a visit from his "chère maître," to whom he professed profound attachment, and in whose affairs both public and private he took a continual interest.

The demand for the book became more and more urgent, and during the next two years Thompson was busy in his spare time collecting material to add to his lectures.

In February 1884 he wrote to his wife from London:

"I have had a busy day. First the Safety Lamp affairs. . . . We meet again next Saturday. After this I interviewed Alexander Siemens about progress in dynamos. Then I went into the City and called at the Telephone Co.'s office; after which I went out by train to Chelmsford to see Mr. Crompton's works and his new Dynamo-Electric machines and lamps. I came back about 6 p.m., called on Prof. Hughes, and on an instrument maker about some apparatus. Then I had some dinner, and after that went

to the Royal Institution to hear Max Müller lecture. Here I saw Hughes again, and Tyndall, the latter only for a moment. It is very curious how the principles I enunciated eighteen months ago are proving to be *solid* in practice. All the makers are remodelling their dynamo-electric machines in agreement with the principles I laid down."

The reviews were quick in appearing when the book was published, and were full of congratulations and thanks for the manner in which the author had supplied the wants of students. The book found no rival in the field in its earlier editions, but even in the absence of the stimulus of competition, "never," declared one amongst the many favourable reviews, "in the whole history of applied science has a more satisfactory first step been made."

It was required at once in foreign countries as well as in America, and there was no lack of offers to translate it into diverse tongues. Only the French translation of the first edition was effected, for after eight months the publishers were already demanding "copy" for the second edition. Even in the short time that elapsed before this was prepared considerable advances in theory and practice had to be recorded, and the volume increased by over 100 pages, and by nearly as many diagrams. One item that evoked particular interest was the elaboration of Dr. Hopkinson's method of studying "characteristic curves" obtained from dynamos, and another was Thompson's reference to the early discovery of the "ring armature" by Pacinotti¹ in 1864, which preceded the better-known "Gramme machine" by some years, but was then unknown even to his compatriots, the Italian engineers. The book received praise for the excellence of its index, a feature to which Thompson attached great importance in all his books.

The work grew; each edition was pronounced "better than its predecessor, and that is saying a great deal," as Professor Ayrton wrote to him about the third. The novel feature in this edition was a chapter containing historical

¹ Pacinotti, Professor at Pisa University. Thompson first met him when visiting Pisa during his extended Easter vacation in 1892. See p. 223.

notes, which some found extremely interesting because it gave the most complete list of workers in this field that had yet been published.

On August 29th, 1888, he received the following letter from W. H. Snell, editor of *The Electrician* :

“DEAR DR. THOMPSON,*

“Of course I am sorry that you were not able to send me the papers on graphic constructions, but I should have been still more sorry if you had sunk into a premature grave whilst labouring to do so. It is quite evident that you have got through an *enormous* amount of work this year, and I am totally at a loss to conceive how you find the time to elaborate those exhaustive historical papers in the midst of your educational duties—to say nothing of research work.

“I am glad you are getting such a thoroughly *laissez faire* holiday,¹ and greatly envy your ability to carry out such a programme. I am sorry that you will not be at Bath, but with the exception of Lodge, Ayrton, and Preece, no one of very great electrical magnitude seems to intend to be there. Preece is going to attack Dr. Lodge’s mathematical theory of Lightning, so we may expect something brilliant.

“Your third edition of *Dynamo-Electric Machinery* came into my hands just as I was leaving town (for four days), and it was only after a severe struggle that my strict sense of duty led me to leave it behind. Since my return I have been dipping into it at every spare moment, but I don’t think any ‘Review’ will appear quite immediately. It is a grand piece of work.”

The fourth edition in 1892 had expanded to a volume approaching 1,000 pages, bound in scarlet, and jokingly referred to as “The Peerage,” or “the big red book,” to distinguish it from “the little red book,” or “L. R. B.” as some of his students called the *Electricity and Magnetism*. Much of the former work had been rewritten in hopes of making it up-to-date, or, as one friend described it, “rather more than up-to-date on some points.” The later editions were published in two volumes, but even then it was found quite

*¹ Thompson was at Glen Sannox in Arran, N.B., with his wife and four small daughters, spending much time sketching. He did not attend the British Association at Bath.

impossible to include the masses of information provided by the rapid development of the industry. The historical portion was compressed, and when his Cantor Lectures on the Electromagnet were published in book form as one of the Finsbury Technical Manuals, some portions of the chapters on magnetical subjects were transferred to that book, *The Electromagnet and Electromagnetic Mechanisms*, to which his brother, Dr. J. Tatham Thompson of Cardiff, contributed a chapter on the Use of the Electromagnet in Surgery. "The book is admirably lucid, and many difficult problems are successfully attacked. In several cases also his conclusions have formed the starting-point for other investigators, and the good seed he sowed has borne abundant fruit."¹

In 1895 much work with alternating currents was already being done, both in England and America, and in the spring of that year Mr. Martin, of *The Electrical Engineer* of New York, wrote to Thompson, "I am most heartily glad you are tackling the subject. It needed your master hand. There is an infinite lot in the way a thing is done." The portion of *Dynamo-Electric Machinery* referring to such work was expanded into his book *Polyphase Electric Currents and Alternate Current Motors*. This was immediately translated into both French and German, as were also the two subsequent editions.

Later he wished to expand his treatment of *Design of Dynamos*, but it was agreed that this should be done in a separate volume from *Dynamo-Electric Machinery*. A great deal of the work for this new book was done during a long wet summer holiday in North Wales. The author sat in the circle of his family, drawing what appeared to them to be a never-ending series of diagrams, of "boosters" and other unfamiliar machines, while *Great Expectations* and other novels were read aloud to him.

Of *Dynamo-Electric Machinery* it was written: "If Professor Thompson had done nothing else, this invaluable book would serve as his enduring monument."²

¹ Extract from *Journal of Inst.E.E.* vol. lv, p. 549.

² *The Electrical Engineer*, 1892.

But in the publication of such a work there was all the ordinary labour involved in going to press, and in addition the difficulties arising from the active rivalries of the persons and firms whose inventions and productions were to be described.

When one of the editions appeared, the author was at once assailed by an engineer on behalf of his design and his firm's execution of a number of engines, which Thompson mentioned as "now being replaced" by those of another firm. Usually so extremely careful to verify and test every statement, Thompson was very reluctant to believe himself misinformed, and guilty of misinforming others. The charge entailed inquiry, correspondence, both private and in the technical Press, the stoppage of the issue of the book, and the cancelling of a sheet to replace it by a corrected one.

In 1902 a much more troublesome affair arose in the preparation of the sixth edition—namely, the case in the Chancery Division known as *Wilde v. Thompson*, which aroused considerable interest among electricians and authors of scientific works. It delayed the book for so long that Thompson published a lengthy explanation in *The Electrician*.

The unfortunate Dr. Henry Wilde, F.R.S., believed that he alone should "enjoy the reputation" of being the inventor of the dynamo-electric machine, whereas, in common practice among engineers and others, the term "dynamo-electric machine" was used to cover many machines besides the type invented by Wilde. From 1899 onwards, Dr. Wilde protested that his reputation was being destroyed successively by the Institution of Electrical Engineers and the Society of Arts, which both had honoured him for his original work, but not for "the invention of the dynamo"; he could not let the matter rest. All Thompson's endeavours to meet Dr. Wilde's demands without committing himself to what seemed to him false statements failed, and the case dragged on, entailing endless worry and expense.

In December 1902 Thompson was feeling very depressed about it, and wrote as follows to Sir William Crookes :

"I think I told you that poor old Wilde had brought an action against me for libel, because I will not describe him as 'the inventor of the dynamo.' It is a libel—a malicious libel—even to say that poor Faraday, when near his end, 'took an interest in the description of Wilde's new magneto-electric machine,' because thereby the said Plaintiff 'is deprived of the credit of being the inventor of the dynamo.'

"Now, you described the Wilde machine in *Q. J. Sci.* for October 1867 in precisely those terms which are now a malicious libel. Could you tell me this, whether Wilde at that date ever objected to this name being given to his machine, or whether he wanted you to call it a 'dynamo'?

"I am ill and worried, or I would come myself to ask you. Pray forgive my troubling you. I am in the middle of preparing my defence. Wilde has retained our friend Fletcher Moulton to fight his case."

Eventually in March 1903, eleven months after the start, it was heard on a motion to dismiss the action as frivolous, on the ground that the Statement of Claim¹ showed no reasonable ground for action. Judgment was given in Thompson's favour, with costs, the complaint of libel being termed "pure nonsense"; and the judge added, "It would be an evil day, if it were the law, that if one man make a concession to another man for the sake of peace, the result is that there is a contract upon which the one can sue the other for specific performances or damages."

Despite this result the case was carried by Wilde to the Appeal Court, where it was heard six months later, when it was again practically laughed out of court. It was, however, no laughing matter to the defendant, and he had many sympathisers, among them the editors of Murray's *New Oxford Dictionary*, which publication contained an article on the *Dynamo* that brought the threat of a similar action against its perpetrators. Thompson had often had queries from the editor on questions of scientific terms, both at this time, and from Sir James Murray himself on

¹ The Statement of Claim asked for (i) an injunction to restrain the publication of *Dynamo-Electric Machinery*; (ii) to restrain S. P. T. from making any mention of Wilde, his discoveries and inventions, in *Dynamo-Electric Machinery* otherwise than in accordance with the agreed proof; (iii) damages; (iv) costs.

other occasions. The following letter from Mr. Henry Bradley is one of many :

“ ‘NEW ENGLISH DICTIONARY’

“ OLD ASHMOLEAN LIBRARY,

“ OXFORD.

“ December 19th, 1903.

“ DEAR PROF. THOMPSON,

“ I enclose two sets of proofs of the Magnet articles in the latest stage so far reached. One copy I send in order that you may keep it for reference. The other copy please return with any remarks or corrections you may be able to make. (You see, the penalty of doing a kind action freely is to be asked to do more ! But I am anxious not to be too exacting.) The slips include the words from Magnet onwards, which I think have not been sent to you before. . . .

“ I had a visit from the new D.C.L. [Wilde] yesterday. He was in a quite amiable mood, perhaps mollified by his reception in Oxford. I asked him to name any scientific man of the first rank to whom I could go in order to obtain an opinion free from the bias which he attributed to the authorities whom I had consulted. His reply was : ‘ Ah, well, you see, unfortunately —— ’ you may guess the rest. I said that, being myself ignorant of science, I could not presume to constitute myself judge in a scientific controversy, nor could I accept him as judge in his own cause ; I was bound to consult the most competent and impartial authorities I could, and to follow their advice. I gave him a copy of my proof, and promised to consider any suggestions, and also to omit any quotation which he thought damaging to his reputation. This morning he came in again with the proofs . . . we parted in all friendliness, though I should not wonder if there is trouble when Dr. Wilde comes to consider things at his leisure.”

In his defence¹ published in *The Electrician*, Thompson wrote :

“ No self-respecting man could have consented to insert in his book, as though they were true, statements which he found to be false, even though furnished to him by a respected and aged inventor, who supposed them to be true.

¹ Never heard in either law court, but elaborately prepared in case of need.

I preferred the worry and the waste of time and money inseparable from a Chancery suit, knowing full well that, when I should have succeeded in my defence against this monstrous attack, the English law could award me no damages to compensate me for the inevitable loss."

Before leaving the subject of Thompson's books, let the verdict on his largest technical work be given in the words of one of his old Finsbury men :

"I wish to thank you for the new edition of your *Dynamo-Electric Machinery*. Your book is in great request at our works. Every now and again some member of the staff creeps into the Engineering Office, where we have a copy,, and asks in a subdued tone of voice if he may borrow the new edition of 'Thompson.' There is a charm about the book, with its illustrations and clear explanations, that makes every student of electricity long to have a copy."

In the first "Silvanus P. Thompson Memorial Lecture" ¹ delivered to the Röntgen Society in April 1918, Professor Sir Ernest Rutherford spoke thus :

"I would like to express the debt which I, and I am sure many other scientific men in this audience, owe to his admirable textbooks. I gained my first knowledge of electricity from *Elementary Lessons*, that remarkable and perennial book which has served to interest and instruct scientific youth, and even middle age, in all parts of the world. This work is marked by that clearness, simplicity, and charm which is so characteristic of all his writings and lectures. If I was suckled, so to speak, on *Elementary Lessons*, I cut my first teeth on *Dynamo-Electric Machinery*, and I can well recall the strong impression left on me by the exceedingly clear, simple, and logical statement of the essentials of a complex subject. In this connection, I call to mind a conversation I had some ten years ago in New York with an editor of a well-known technical journal, *apropos* of the rapid growth of electrical engineering in U.S.A. He remarked on the eagerness and almost excitement with which the publication and first arrival of S. P. Thompson's *Dynamo-Electric Machinery* was awaited in his country, and the strong influence this book had exerted in

¹ *Journal of the Röntgen Society*, No. 56, vol. xiv.

leading to a correct understanding of the fundamental facts and theories on which the science of electrical engineering is based."

III. RESEARCHES, INVENTIONS, AND COMMUNICATIONS TO SOCIETIES

Thompson's first communication to the Royal Society was not made until 1884, when a paper in connection with his electrical work was read there—viz., a "Note on the Theory of the Magnetic Balance of Hughes." The instrument had been recently described by its inventor, Professor D. E. Hughes, F.R.S., and was considered likely to be of great convenience and usefulness for work in the laboratory ; it had, however, only been graduated by empirical determinations for a small number of values, the remainder to be found by interpolation. Thompson worked out a formula for its graduation, and submitted it to Hughes, from whom he received the following letter :

" January 15th, 1884.

" DEAR PROF. THOMPSON,

" I have received yours this evening, and as I shall be very busy the next few days I wish at once to express my sincere thanks for the formula you have kindly sent for the graduation of the magnetic balance. It seems perfectly correct, although I believe it might be reduced to a simpler expression.

" The real difficulty is this—we cannot have the distance a constant. . . . If you have the time and find the formula for all cases please publish a paper on the subject, either at the Royal Society or elsewhere ; it would be extremely useful.

" At present I am too busily engaged with *molecules* to do anything until I have got hold of one of them and demonstrated its existence.

" With many thanks, believe me, with the highest expressions of esteem,

" In haste,

" Yours,

" D. E. HUGHES."

Thompson continued to work at the formula and report progress, receiving constant encouragement from the older man, who knew that it was sufficiently important for others also to be engaged on the same work, but who always wrote of his own eager pursuit of "a molecule, and a molecule *I must have.*" He gladly acted "as sponsor" for the note for the Royal Society, and saw to its publication in the Proceedings.

Enough has been said in other chapters of Thompson's earlier researches connected with improvements in apparatus, communicated to the Physical Society of London, and of his inventions of telephone details, and of the magnetic figures. His interest in influence machines has been mentioned in connection with his friendship with Wimshurst, and his own pamphlet on the history of the subject; he described "A Modified Water-dropping Influence Machine" in the *Philosophical Magazine* in 1888.

The outstanding researches of the years 1883-6 were published in the *Philosophical Magazine*, one on "The Graphic Representation of the Law of Efficiency of an Electric Motor," and several on the fundamental principles of the Electromagnet and Dynamo, and the mathematical theories and formulæ which express the essential physical basis of all practical construction of these machines. They bore witness to his careful study of contemporary Continental work on the subject. One of these papers in the *Philosophical Magazine* was translated into German, and appeared in Exner's *Repertorium der Physik*, 1886.

1888-91 were the years of most active interest in electromagnetic problems, which were the subject of his Cantor Lectures and of his presidential address in 1890 to the Junior Engineering Society, now the Junior Institution of Engineers. It was in connection with this subject that he became so eagerly interested in the work of William Sturgeon the electrician, and set about unearthing all existing records of the discoveries and personality of that remarkable English worthy, who, escaping in early youth from a position of poverty and degradation, as apprentice to an unworthy shoemaker, to the comparative leisure of a private soldier

in the Royal Artillery, educated himself in natural philosophy, and particularly in electrical science, to such purpose and extent that, later on, making his own apparatus, and writing clearly of his researches, he was able to communicate at least one of these to the Royal Society.

A few years later Thompson again devoted a considerable amount of time to problems of magnetism, working in conjunction with Mr. Miles Walker, his pupil, assistant, and secretary. Together they presented papers to the Physical Society reporting their experiments and conclusions. Their most important piece of work on "Electric Traction by Surface Contacts," which they described to the British Association, Section G, was reprinted in *The Electrician* in 1898. At that time everyone was disgusted by the weight and the rapid deterioration of accumulator cells; many local authorities objected to overhead wires, and tramway companies wished to avoid the expense of continuous conduits with open slots. A great many plans for surface contacts had been already devised, but all had their defects. Thompson and Walker designed a system which they believed combined the advantages of the earlier inventions, but overcame their lack of safety or lack of power. The engineering firm Baker & Sons of Willesden, the heads of which were Quaker friends of Thompson, assisted him by the construction of an experimental tramline near their works at Willesden Junction, where the various suggested arrangements were put to practical tests. In the end the inventors were satisfied that their peculiar system of isolated metal studs, from which the vehicles picked up electric power as they went along, did answer in the affirmative the three fundamental questions: (i) Is it possible to lay surface contacts in a roadway, so that they do not cause any obstruction to traffic? (ii) Is the method of picking up current from studs by means of a skate on the vehicle feasible under practical working conditions—*e.g.*, wet, mud, street refuse such as paper, etc.? (iii) Can the studs be made perfectly safe, so that there is no possibility of current being accidentally drawn from them in the absence of a tram?

In the following year, Mr. Walker read to the Institution of Electrical Engineers, of which he was then an associate, a paper on the work he and Mr. C. E. Holland had done at Willesden under Thompson's direction. The verdict of that body was favourable, and it is suggested by Dr. Alexander Russell ¹ that the system might have become popular had the local authorities in this country made a firmer stand against the erection of overhead wires.

Patents were taken out, and with his usual optimism, Thompson was full of hopes of the adoption of their scheme for some locality where the simpler and less expensive overhead wires were unsuitable. This venture, however, was no more successful than his others, and the financial outlay was a loss serious enough to check all further attempts of this kind.

Of later technical work there remain two important subjects to mention. In *The Electrician* of 1894 he published his "Notes on Rotatory Field Motors," compiled for the use of Finsbury students, and printed as being probably of service to others in aiding their comprehension of the operation of this little understood class of machinery. A few years later he read to the Electrical Engineers a long paper on Rotatory Convertors, which was considered "of such importance that a second evening was devoted to its discussion. During this several speakers agreed in the view that Dr. Thompson was the first systematically to elaborate and present the subject in palatable form. "To many no small part of their present knowledge of the subject was first given in this paper." ²

¹ *The Journal of Inst.E.E.*, vol. lv, p. 549.

² It was on the occasion of this debate that Thompson gave utterance to a very characteristic expression of views on the subject of the value of words. Many speakers used "Rotary." "Lastly, let me protest against the insinuation that in using the good old adjective 'rotatory' I have altered the English language. The old English language has many adjectives like 'rotatory,' 'explanatory,' 'inflammatory,' 'sanatory,' and 'undulatory,' but I do not think any of those adjectives would be improved by cutting out what might seem an unnecessary syllable. I think such clipping would not add either dignity or literary—perhaps I ought to say 'litary'—form to any communication that might be written in such an abbreviated language."

His last work in this field was a prolonged research upon the magnetism of permanent magnets. He published several papers between 1909 and 1915 on his own work and that of his student secretary, Mr. Ernest Moss, under his direction ; and lectured to the Institution of Electrical Engineers at the great Glasgow meeting of that body in 1912. At the time of his death he was preparing a book on Permanent Magnets, part of which was outlined as a historical study drawn from the resources of his own library, leading up to a much needed exposition of the most recent work on the subject.

Another phenomenon which always fascinated Thompson, and at which he worked from time to time, was the curious dust figures of Lichtenberg, obtained by sifting mixtures of red lead and sulphur upon plates of shellac or glass on to which electricity has been discharged. They formed the subject of a Preliminary Note to the Royal Society in 1895, but further work on the nature of electric discharges was then postponed by his ardent pursuit of the newly-discovered Röntgen Rays (see Chapter X) ; and he does not seem to have investigated the matter further, though it was not lost sight of, and was included in the subjects of the last of his Royal Institution Discourses, in March 1916, on "The Corona and Other Forms of Electric Discharge," when he displayed, with his usual delight, the extraordinary and brilliant stellate or dendritic patterns to be obtained by scattering various electroscopic powders on sparked surfaces, and endeavoured to apply the knowledge concerning the nature of the electric discharge so obtained to practical questions such as have to be faced in attempts to transmit electricity from central stations at tremendously high voltage.

In connection with his work on alternating electric currents, Thompson developed a lively practical interest in that branch of mathematics known as Harmonic Analysis. In 1904 he read a paper to the Physical Society which showed his familiarity with many of the various attempts of mathematicians to simplify the methods of this analysis, and he described in his paper, and later in *The Electrician*

for the benefit of technical workers, "A Rapid Approximate Method of Harmonic Analysis." He continued to work at this for some years, and in 1911 presented to the Physical Society a second paper on what he called a "New Method of Approximate Harmonic Analysis." This method was also described in a paper read before a Swedish Society a few months later, and printed in the *Arkiv för Matematik, Astronomi och Fysik* of Upsala and Stockholm. The method is described in eight short pages, quite as obscure as Chinese to the lay mathematical mind, but evidently appreciated by those with sufficient training to follow its argument; and in June 1914 he was requested to allow his method, with its scheduled forms, to be incorporated in the Handbook of an exhibition of forms for facilitating Harmonic Analysis, at the Napier Tercentenary Celebrations held at Edinburgh that summer.

He heard from his "collègue," Professor G. Lippmann of the Sorbonne, that his paper had been presented to the Académie des Sciences, and accepted for incorporation in the *Comptes Rendus*, but was afterwards found to exceed the prescribed length for that publication.

Thompson was anxious to have his method tested by applications to practical data, and communicated with the workers at the National Physical Laboratory at Richmond and Bushy, who dealt with tide observations, and magnetic and meteorological statistics, to which harmonic analysis was occasionally applied.

Dr. Alexander Russell sent him several helpful criticisms of his papers, and drew his attention to some previous work of Gauss, concluding: "I think it adds to the value of your method that a man like Gauss thought something like it deserving of the most serious study." Of the last paper he wrote: "I think that you have made it very hard for anyone to simplify harmonic analysis any further."

The same friend wrote thus of Thompson's work in this field: ¹

"He loved music and had an accurate musical ear. The valuable paper which he read to the Physical Society in

¹ *Journal of Inst.E.E.*, vol. lv, p. 550.

1910 on 'Hysteresis Loops, and Lissajous' Figures' was a happy mixture of magnetism, sound, and mathematical theorems. In solving mathematical problems and inventing new mathematical theorems he took the keenest delight. He did most excellent work, for instance, in simplifying Runge's method of practical harmonic analysis. He was dissatisfied, however, with the accuracy obtainable by this method. He then invented a series method of harmonic analysis. The writer remembers how pleased he was when he first discovered it, and with what mutual pleasure we discussed it. He greatly appreciated the lectures which Dr. Kennelly of Harvard gave at the Institution some years ago. In proposing a vote of thanks to him he expressed himself, as usual, most happily. He said that he felt constrained to exclaim, 'Great is the Hyperbolic Angle, and Kennelly is its Prophet!'"

Thompson took a keen interest in hyperbolic trigonometry, and contemplated writing a little treatise on the subject, which was to have been a companion volume to the *Calculus made Easy*. He and his old student, Mr. Maurice Gheury, had already partly planned the work in 1914, but like much else it was cut short by the war.

CHAPTER VI

TELEPHONE RESEARCH AND "LIFE OF PHILIPP REIS"

It has already been mentioned that among the early researches of Thompson, the subject of Binaural Audition had taken a very prominent place.

Some work on the same lines had previously been done by Lord Rayleigh in 1877. In a letter to Thompson of February 1879, Dr. Sedley Taylor, of Trinity College, Cambridge, writes, "I am very glad you are going to take up this hitherto much neglected subject." Thompson had before that published papers in 1877 and 1878, and also had read a communication in French to the Congr s de Paris of the Association Fran aise pour l'avancement des Sciences, under the title of "Sur des Ph nom nes de l'Audition Binauriculaire" in the latter year.

During these researches he made use of the telephone invented in 1876 by Graham Bell, and his attention was attracted by this wonderful instrument, with its combination of electrical and acoustical properties. He began to try to work out a mathematical theory for it. In 1879 he had some correspondence with Graham Bell on the subject, who wrote on March 7th :

"Your note of February 21st received ; the experiments made by me in London on January 30th, 1878, with two pair Telephones have not yet been published. I have continued those experiments. I am engaged just now in preparing a work upon the History of Electric Telephony. I remember especially a communication having reference to the phenomena of binaural audition observed by yourself. I have made a note of this, and will forward the reference as soon as I can find it. . . ."

In December he wrote again :

“Your two notes dated the 9th and 10th instant respectively received. I need not tell you how much pleasure it has given me to hear from you. I do hope that plenty of time and opportunity will now be given you for original research in Bristol. It would be a shame to force you to seek a professorship elsewhere, in order to have time to carry on the valuable researches that are already bringing your name into prominent notice on both sides of the Atlantic.

“I have been much interested in the Pseudophone, and have read your paper in the *Philosophical Magazine* for October. I read a paper at the last meeting of the American Association for the Advancement of Science, upon some experiments relating to Binaural Audition which you would be interested in reading. . . . If you would like to make use of it in your monograph on *Binaural Hearing* I shall be glad to send you advanced sheets.”

The Pseudophone to which Mr. G. Bell referred was an instrument invented by Thompson for investigating the laws of Binaural Audition. He read an account of it before Section A of the British Association at Sheffield. It enabled him to study the subjective perception of two sounds led separately to the ears and differing in pitch, phase, or intensity.

In January 1880, in the course of a long letter on the same subject, A. Graham Bell writes :

“I should like to know more about your instrument for analysing compound tones without using resonators ; when you are prepared to make known the details of it, please remember my interest in the subject.”

This new instrument, also devised by Thompson, he styled “A New Phonautograph.” It was a distinct improvement on the original Phonautograph invented in 1859 by Léon Scott de Martinville of Paris. It was intended for investigating the quality of the consonantal sounds, and enabled Thompson to carry out more exact records of these than had been possible with the earlier instruments.

About this time Graham Bell brought out a very beautiful

little instrument called the Photophone. Thompson, in lecturing to the Leeds Philosophical Society on "Waves of Sound and the Photophone," described to a large audience the new invention, and also wrote on it in *Nature*. He immediately began experimenting with it, and in a letter of October that year, Graham Bell sent him numerous drawings and diagrams of improvements in his instrument. In November, Thompson wrote to Miss Henderson :

"I was very lucky yesterday in a little theoretical investigation about the Photophone. Two little mathematical calculations came out beautifully, and I can now tell Graham Bell, in the most positive way, how his instrument can be theoretically improved. Also a quite separate little geometrical problem suddenly solved itself in my mind last night : not a very important problem, but a pretty one."

In November, Graham Bell wrote :

"I am much interested in what is stated in the Leeds newspapers about your improved Phonograph. I should very much like to have any particulars concerning this that are published or that you may care to make known at the present time."

This friendly interchange of their researches went on between Thompson and Graham Bell for some years. He was also carrying on frequent correspondence with Professor Barrett, to whom he wrote in February 1880 :

"I am very much pleased to hear that the suggestion I made as to the possibility of using the Motograph Telephone as a transmitter turns out successfully after all. I never dreamed, however, that there would be an E.M.F. of anything like $\frac{1}{2}$ volt. Did you observe whether this varied with the rate of rotation to any extent ?

"I was sorry, too, that I did not succeed at Birmingham. I ran Poynting closely, being second ; but was not surprised when I found the very high opinion the Trustees had formed of him. He was second wrangler and Smith's prize man, and his collegiate experience nearly doubled mine. . . .

"Have you seen de Fonvielle's shallow and blatant attack in *L'Électricité* upon Crookes' Radiant Matter in

particular, and the Kinetic Theory of Gases in general ? It is very stupid.

“Pray excuse this brief note. I am working at high pressure. This is our heavy term, and we have in addition science lectures *in partibus*.”

In January of 1881 Thompson read before the Physical Society “Notes on the Construction of the Photophone,” in which he stated that in certain experimental observations he had been led to query whether Professor Graham Bell’s arrangement was the best possible one. He therefore brought forward three theorems of construction which, being carried out, caused considerable improvement.

An article on this new form of the Photophone, with diagrams, appeared in *Engineering* on February 4th, 1881. The Monograph of all the researches on Binaural Audition appeared in the *Philosophical Magazine* for June 1882, and was entitled “On the Function of the Two Ears in the Perception of Space.” In it Thompson reviewed all that had been done on the subject by Professor Mach of Prague, with whom he had been in correspondence, by Lord Rayleigh, who had also consented that what he had done should be quoted, by Graham Bell, and by himself, and ended by proposing the theory which he believed to cover all the facts observed, up to that time.

While making all these small researches, Thompson had also been engaged in numerous experiments with telephones themselves. His Problem Books, in which he kept a list of ideas to be worked out, are full of suggestions of new forms. In this country the only well-known forms of the telephone were those invented in America by Dr. Graham Bell and Mr. T. A. Edison, but during one of his visits to Germany, Thompson had come across an earlier form of telephone, which was regarded there as the original and first telephone invented. He was much interested in it, and set about tracing the history and construction of this instrument.

In January 1882 he was giving some lectures in Lancashire and Cheshire, and wrote to his wife :

“I had an hour in Manchester with Mr. Horkheimer, a former pupil of Reis, who told me lots of things about the

telephone, and is going to give me two which he himself had set up in his house in 1875."

A few months later he published the results of his investigations in a lecture to the Bristol Naturalists' Society entitled "The First Telephone." This invention, made by an obscure German schoolmaster named Philipp Reis, had been first exhibited at a meeting of the Physical Society of Frankfort in 1861, when the author sent in a memoir "On Telephony by the Galvanic Current." Next year it had been shown by Philipp Reis himself to a crowded audience in a large hall in Frankfort. Thompson had procured some of the apparatus made by this man, and the reprint of his lecture was illustrated by drawings of it made by himself. The most interesting form was a receiver of wood made in the form of a human ear, with a metal tympanum against which rested a curved lever of platinum wire. Graham Bell had known of this invention, and both he and Edison had referred to the prior work of Reis.

The lecture on "The First Telephone" brought many inquiries, and his interest in the personality of the inventor was so great that Thompson decided to write a biography of him. The short accounts of Reis existing in Germany were too sketchy to satisfy him, so early in 1883 he began his second book. Much of it had already gone to press when during the long vacation he went to Germany, accompanied by his wife, and spent several weeks in prosecuting inquiries amongst the surviving contemporaries of Philipp Reis. The son of the inventor, Carl Reis, at that time lived in Frankfort, so the first part of the time was spent in that city. From there he went on to the Taunus district, staying at Homburg and visiting Soden, where dwelt one of the contemporaries of Reis, who was able to give much useful information about his work and his experiments.

Reis was one of those men of inventive genius who were little appreciated during life; he died at the age of forty, so did not see the fruition and recognition of his work.

His widow and daughter lived in the little village of Friedrichsdorf, some miles drive through the forest from

Homburg. They were quite poor, but of a refined and well-educated type, and received most warmly this English professor who was such an enthusiastic admirer of the humble schoolmaster. The Garnier Institute where he had taught for several years, and the schoolroom where he had put up one of his first telephones, connecting it to the physical cabinet of the Institute, were visited. Various small inventions made by him were shown, including a very primitive bicycle. Then Frau Reis led the way to the cemetery, where stands the monument to Philipp Reis erected in 1878 by the members of the Frankfort Physical Society. An engraving of this appears in Thompson's biography of him.

The holiday was not entirely devoted to this literary work; time was found to hear many of Wagner's operas in the fine Opera House at Frankfort, and a pilgrimage was made to Bayreuth to hear *Parsifal*, given as Wagner himself had arranged and directed before his death in the previous year. Thompson was an ardent admirer of his music, which he had first heard in the Albert Hall in 1876.

The book was published by Messrs. Spon early in the autumn of 1883, but it never had a very large sale; many thought that Thompson had estimated too highly the work of Reis as a pioneer of Telephony. It was, however, received with much appreciation in Germany, as doing honour to a native of that country. Both in England and America too it was recognised by some scientific men as a "most important contribution to the history of telephony." In the latter country a very appreciative review of it appeared in the *Popular Science Monthly*.

In 1892 Professor Leopold Petsik of the Staatsgymnasium, Trieste, wrote to the author that he was about to publish a paper on the History of Telephony, and that he had "found very much information in your excellent book on Philipp Reis." Thompson never abandoned his belief that Reis was the first inventor of this useful instrument. His former master and friend, Professor Quincke of Heidelberg, had written to him, recounting how he had been present at the meeting of the German Naturalists' Association held at

Giessen in 1864, when Philipp Reis showed and explained the telephone he had invented :

“I listened at the receiver part of the apparatus and heard distinctly both singing and talking. I distinctly remember having heard the words of the German poem ‘Ach, du lieber Augustin, Alles ist hin.’ The members of the Association were astonished and delighted.”

In 1914 an article appeared in *The Times* on “The Story of the Telephone” which roused Thompson to send the following letter to the Editor :

“Your contributor who writes on p. 6 the article entitled ‘The Story of the Telephone’ makes an extraordinary blunder. He says: ‘On March 10th, 1876, he [Bell] succeeded in sending spoken words along an electrified wire. No one had ever done this before. Edison had not. Reis had not. Bell invented the telephone first and alone.’ Either your contributor does not know the facts, or else he deliberately misstates them. Philipp Reis invented his ‘Telephon’ and called it by that name in 1860. It was invented for the express purpose of transmitting speech by electricity. He exhibited it to scientific societies repeatedly in the years from 1862 to 1864. Eminent scientific men are still living, some of them pupils of Reis, who heard spoken words through it at the time. Their testimony has been collected in my work *Philipp Reis: Inventor of the Telephone*, published thirty years ago.

“Surely the work accomplished by Dr. Alexander Graham Bell is sufficiently well recognised that there is no excuse for his admirers to advance, on his behalf, an untenable claim.”

Although of a gentle and pacific nature in his personal relationships with individuals, Thompson was a trenchant controversialist, most anxious that credit should be given to the earliest pioneers of science, and most ardent in the defence of truth. During his lifetime he had many controversies on scientific and educational subjects, both in the pages of the Scientific Journals and in the columns of *The Times* or *Saturday Review*.

Thompson took out a patent for “Improvements in Telephone Instruments” in May 1882. He had also lectured on Telephony in various parts of the country, so was re-

garded as an expert on the question. During the long vacation of that year he was obliged to spend some weeks in London as adviser to a telephone company which had been started as a rival to the United Telephone Company, which was endeavouring to create a monopoly in this country with the patents of Bell and Edison. As that company refused to sell their instruments, and charged a very high rent for them, the idea of obtaining a cheaper form of telephone was very much in the minds of business people, who were anxious to obtain telephones which they could use between their private houses or offices and their factories.

Electrical engineers were constantly at work experimenting to devise some form of telephone which would not infringe the patents of Bell and Edison. Among them was Thompson with his keen inventive brain, which suggested and rejected many a new form, as his problem books of that period show.

This was the first time he had been called as an expert witness in a patent case, and he found it weary work, while he was longing to be off sketching in the Highlands of Scotland, where his wife and baby daughter were staying. To her he wrote: "How is my pretty wee rosebud? I don't forget my daughter in thinking of my ducats." In after-years, when patent cases took up much of his time, he found the resulting "ducats" came in very usefully for the education of the daughters.

After the publication of his *Life of Philipp Reis* he continued his experiments in telephone improvements, taking out several patents which excited interest among those who at that time were anxious to break down the monopoly of the United Telephone Company, both in this country and in America. At last he produced a new telephone with a valve transmitter and Reis receiver, which were both of his design, and a syndicate was formed to buy them from him. The Attorney-General of the day gave his opinion that the telephones invented by Professor Silvanus Thompson did not infringe any of the patent rights held by the United Telephone Company.

The following letter, written from London in July 1884 to his wife, gives an account of the starting of what was called "The New Telephone Company" :

"The negotiations which Mr. W. has been quietly carrying on for me to try and effect a sale of my telephone patent rights are coming to a head, and I found at Paddington a message from him. He has had part of the instruments for some time. The proposal is to form at present a syndicate, to take the thing up in a preparatory way ; which will put a little capital into the affair—enough to provide means for manufacturing a lot of instruments, and paying some of the expenses incurred in patenting. Then after a few months, when the thing is developed, they will take over the patents, and begin to pay royalties. Meantime, though I get nothing more than expenses, probably, I shall incur no risks."

That year the British Association was being held for the first time out of Great Britain at Montreal, Canada ; Professor Thompson had intended to sail with the party of scientists who were going there in the *Circassian*. He was, however, detained in London by details connected with the Telephone Company, and had to postpone his departure until the eleventh hour. He wrote to his wife :

"This telephone negotiation drags most wearily ; I shall not remain here beyond to-morrow, whether things are concluded or not. It is in good hands, but there is a great deal to do. Each man who thinks of taking part in the concern has his own ideas how the thing should be managed, and it is very tedious talking the people round point by point."

The New Telephone Company got its prospectus out in November 1884, and began to advertise its instruments, which it sold outright to its customers under licence from the Postmaster-General.

In the Inventions Exhibition of 1885 the Company showed their "New Patent Valve Telephone invented by Professor Silvanus Thompson." The inventor was paid for his instruments by shares in the company, and he was made a director.

The Company was immediately inundated by inquiries from all parts of the country, but as soon as some of the instruments had been installed, and a commercial success was in view, the United Telephone Company brought an injunction against them for infringement of patents. Then followed a lawsuit in Chancery in which the New Telephone Company was defeated. It was taken to the Appeal Court, where Lord Justice North again gave the decision against them.

In the transmitter of Silvanus Thompson, the valve was used instead of a diaphragm for the transmission of speech. Lord Justice North gave his judgment that "every surface which can vibrate is a diaphragm." This decision, of course, completely ruined the New Telephone Company's prospects, and the directors were obliged very soon to wind up its affairs and go into bankruptcy. This was finally settled up in 1889.

Professor Thompson received much sympathy from some of his friends, to whom the decision was a complete surprise. Mr. Walter Palmer wrote :

"I do not understand Justice North's definition 'every surface that can vibrate is a diaphragm.' This seems to me most monstrously unfair. I conclude, however, that I for one as a shareholder must acquiesce in what the board have decided and arranged, although I am extremely sorry, firstly because your company has come to grief, and secondly because the same fate doubtless awaits several other companies, and it will lead to the monopoly of the United Company being much increased. I hope we may have the opportunity of meeting before long."

A few months later Thompson wrote to another of his friends who had been a loser :

"Although I cannot for a moment admit that you have any legal claim against the directors personally, yet it is clear that yours is a hard case, and I shall be glad if you will, as a friend, allow me to give you my personal assurance that I will see, so soon as things are settled with the liquidators, that you are not a loser by these instruments."

He received the following reply :

"No, I'm blest if you shall ! I appreciate your great kindness, but you have been treated badly enough already. I shall not forget your kindness ; but do get it out of your head that I care a button for the *£. s. d.* ! I value your friendship even more than I did, and I feel more sorry for your loss than for mine in this little affair."

After the collapse of the New Telephone Company, the problems of telephony still continued to interest Thompson, and in 1893 he took out a new patent for Ocean Telephony. That year he was one of the British delegates to the Electrical Congress at Chicago, and also held the appointment of judge in the department of "Instruments of Precision" at the Great Exhibition. At this Congress he communicated to one of its sittings his new discovery, in the form of a paper which attracted world-wide attention as the earliest pioneer work in Ocean Telephony. His discovery as described by Dr. Alexander Russell¹ was a method for diminishing the distortion of the electromagnetic waves in submarine cables used for telephony. The method was to insert inductive shunt circuits or leaks across the two lines of the cable, or between the line and the earth. Dr. Russell wrote :

"It undoubtedly equalises the 'attenuation' at different frequencies, and so improves the clearness of the articulation. Unfortunately, however, it greatly diminishes the loudness of the sound. The method is a perfectly valid one, and useful in certain cases."

The invention was never adopted by any of the cable companies, and was later superseded by Pupin's invention. At the time, however, it was hailed in America as a remarkable contribution to telephony.

Some years later Dr. J. A. Fleming, Professor of Engineering at University College, wrote as follows :

"DEAR THOMPSON,

"In my book *Propagation of Electric Currents in Telephone and Telegraph Conductors*, I have mentioned

¹ In the *Journal of Inst.E.E.*, July 1917.

your 1893 Patent (see p. 106), but had not space to discuss the claims.

"I have always regarded Pupin's contribution to the subject to be his experimental and mathematical proof of the right distance for spacing coils, and not in any sense as a first suggestion for 'loading' generally (see my book, p. 109). You certainly deserve credit for the modes of constructing highly inductive circuits to be used as shunts, and if you had received more encouragement from the practical monopolists, G.P.O. and Telephone Camps would no doubt have been able to anticipate Pupin. . . . The mathematics is, however, very complicated, and I should be sorry to dogmatise. Owing to expensive nature of the work, experiments are difficult."

Thompson had paid his first visit to America in 1884, when he attended the British Association Meeting at Montreal. His fame as the author of *Dynamo-Electric Machinery* had spread widely both in Canada and the United States, and the scientific journals commented frequently on his youthful appearance, "still on the sunny side of forty," as one of them expressed it.

The Meeting of the Association was a brilliant one, from the presence of a large number of scientific stars of the first magnitude. Lord and Lady Rayleigh, Sir William and Lady Thomson, Oliver Lodge, William Ramsay, and many others.

Thompson wrote to his wife:

"This morning before breakfast a party of us, including the Ramsays, Sollas, and others, went to Lachine to shoot the rapids in the steamer—it is very fine.

"People are most hospitable here, Graham Bell and I are great friends! The debates in Section A are exciting. Sir Frederick Bramwell made a splendid Lion King at the Red Lion dinner. His jokes from the chair were superb. Sir William Thomson was described as being neither the head nor the tail of the 'Ass,' and therefore 'no end of an ass.' We had a splendid mock speech in French by the Hon. Mr. Freemantle, duly translated by Jackal Roberts. There were also speeches of very witty kinds from Preece and Henry Wood. I gave my lecture on the 'Electricity of the

Cat' (illustrated by cartoons), amid roars and howls of applause."

Silvanus Thompson, his cousin Isaac C. Thompson the zoologist, and Oliver Lodge, made up a little party and went a tour in Canada on their way to Niagara. They visited some of the Thompson cousins living in Toronto, and then had a quiet time inspecting the Falls at their leisure. Afterwards Thompson and Lodge went on to Philadelphia, whence he wrote to his wife a week later :

"This has been a hot—nay a scorching—week, with much to do, and little possibility of rest. Between the meetings of the American Association, the meetings of the International Electrical Conference, and the visits to the Electrical Exhibition, I am feeling considerably jaded, and I hail with pleasure the chance of running off to Boston, where there are cool sea breezes.

"Philadelphia and the Philadelphians are simply charming: but the American Association is disappointing in many ways. The quality of the papers read is decidedly inferior. I have come across some most delightful Friends here: an old bachelor Dr. Levick: also President Chase, LL.D., of Haverford College, and his brother, Professor Pliny Earle Chase, of the same College, who is a great mathematical genius. It has been intensely interesting meeting all the American electricians and scientific men here. Graham Bell and Elisha Gray were both here. I have not seen Edison yet, but shall meet him in New York. I made a long speech yesterday at the Electrical Conference on the subject of Dynamos, and found that what I had to say was very well received. Most people whom I have met have been frank enough to express surprise that I had not a long grey beard and a bald head. The Electrical Exhibition is a very interesting show, but there are very few novelties."

During this visit Thompson formed several lifelong friendships with men whom he admired and liked, and which were renewed on his subsequent visits, or when his friends came to Europe.

On the occasion of the great Chicago Exhibition of 1893, many Congresses were held, and during the time, when

he was serving on the Jury there, he again attended the International Electrical Congress.

To his wife :

“An Electrical Congress is always a busy time ; but in this city of magnificent distances and with all the local circumstances of the occasion, it is doubly a cause of toil.

“Yesterday morning was Jury work as usual ; but in the afternoon the Congress met.

“I left the Exhibition about noon, and travelled down by the Illinois Central Railroad to the ‘down-town’ station at Van Buren Street in the heart of the city, close to the Institute where the Congress was to meet. Helmholtz had already arrived in the morning, and there were many others to greet whom I had not seen for years—Elihu Thomson, Professor Eddy, and a score more. The opening meeting, which was given over to greetings and formal business, was held at three o’clock. It was a great success, and everything went without a hitch. Elisha Gray presided, and did his part very well. Helmholtz¹ was received with immense enthusiasm, and Ferraris² and Mascart³ came in for warm welcomes. Preece⁴ was well received and made a very short speech. Ayrton⁵ made a very witty address which delighted them all. . . .

“The last paper in the morning was mine on ‘Ocean Telephony.’ It was extremely well received ; and at the end I received an ovation.

“Some of the Americans say this will be the event of the Congress. The discussion on it was adjourned. Meantime I am preparing weapons for reply.

“In the afternoon there were no section meetings : but we held a sitting of the ‘Chamber of Delegates’ from the various Governments. Besides this work of attending Congress and Chamber of Delegates, I have been on two committees : so that my hands have been full.

“One of the most curious features of the Congress is the absence of certain persons. Edison is known to be in town ; but has not once turned up. He has not even been

¹ President of the Reichs Anstalt, Berlin.

² Galileo Ferraris of Milan.

³ Professor Mascart of the Sorbonne, Paris.

⁴ Sir William Preece of the London Post Office.

⁵ Professor W. E. Ayrton, of the City Guilds Central College, South Kensington.

suggested for any post as Vice-president or other prominent part : but the catch-penny Press has been full of his portraits and biographies, referring to him as the brightest star of the Congress ; and talking of Von Helmholtz as the ' Edison of Germany.' Another absent person is Graham Bell. He was named by Government as the temporary President of Section C. But he never turned up, and, curiously enough, nobody seemed to expect him to do so. Gray is universally esteemed and loved : and he is chairman of the Congress."

To the same on August 26th :

" At last the Congress is over, and I can breathe again. It has been a very closely packed time ; and I have not been the least busy of the six-and-twenty delegates of the Official Chamber. I had just time on Wednesday to write you that my paper on ' Ocean Telephony ' had been well received, and that I had won over into belief in my plans several of the men of whom I had the most fear—namely, the cable engineers. As it turns out, my paper and the discussion on it have been one of the features of the Congress ; and I have received congratulations right and left.

" The Sections met only in the mornings. One could not attend more than one of them each day ; and it was, in the absence of proper preliminary arrangements, very difficult to learn what was going to come off.

" On Wednesday morning I had to make my reply to the discussion ; and afterwards I took part in the debate on Long-distance Transmission of Power. Another day I took part in the discussion on Ayrton's paper—which is a most valuable one—on the Phenomena of the Voltaic Arc.

" On most days the official Chamber of Delegates met in the afternoons in a room in the Union Pacific Hotel. We had some very warm discussions ; and much of the work had to be done by sub-committees. I was put on that upon the consideration of the Unit or Standard of Light : and of that sub-committee they made M. Violle, of Paris, the chairman and myself secretary. As the committee consisted of two Germans, one Swiss, one American, and the chairman and secretary, the proceedings were in several languages, mostly French and German. The secretary therefore had a lively time of it ; and his rough notes were highly polyglot in form. The two Germans worked very

hard to put upon us as a standard lamp one that has been rejected in England ; but we defeated the proposition, and left the question undetermined.

“ Thursday evening witnessed the banquet given to the official delegates. It went off extremely well ; the speeches being witty from first to last. Professor Gray, who presided, led off in a most charming way. Mascart was very amusing and so was Preece. This was the only affair at which Mr. Edison put in an appearance ; I was quite shocked to see how old he had grown. He refused to make any speech, though called upon. The closing meeting of the Congress next day somewhat resembled those at the end of a British Association meeting.

“ In the evening I returned to the Exhibition, first to meet two of my former students, and secondly to hear Tesla lecture. The latter affair was not brilliant ; but it was of great scientific interest.

“ This afternoon Preece and the British delegates held a reception at the house of the British Commission. We had a large number of the electrical folk—the Congress at large—in attendance, and altogether it was a pleasant time. Now I am going out again to see some experiments of Elihu Thomson’s. He makes real lightning 6 feet long ; and shows some extraordinary effects.”

During his stay in the States, Thompson was the guest both of Professor Elisha Gray and Mr. Elihu Thomson in their homes, and he often talked of the delightful hospitality which he had received from them. While at Lynn he spent a whole day in the electric works of the latter.

To his wife from Boston :

“ To-day I have called on one or two folk ; have visited the Art Museum, have inspected an electric lamp factory and hunted over a famous old book store.”

In New York he visited Edison and saw his laboratories, in which one of his own old students was assistant.

CHAPTER VII

REMOVAL TO LONDON; WORK AT FINSBURY COLLEGE

THE position of Bristol University College as compared with other newer University Colleges, and their provision for meeting the increasing demands of the time for scientific training, was very far from being ideal during the years 1883-4. The great obstacle to progress in every direction was the lack of proper endowment and financial support.

During a visit paid at Easter 1883 to Liverpool, and to the laboratories of his old friend Mr. Oliver Lodge, then recently appointed Professor of Physics at the University College, Thompson was filled with admiration and envy at seeing the liberal provision of space and equipment provided for the scientific Professors by the generous gifts of the wealthy merchants of the town.

Notwithstanding the renown of some of the staff and the attainments of the Principal of the Bristol College, Dr. William Ramsay, little progress had been made since the opening of the first wing of the new building in 1882.

The Electrical department had attracted clever students from different parts of the country, but the wretched equipment discouraged research, and prevented the entrance of others.

Great dissatisfaction was felt by all the Staff of the College, and it culminated when a proposal of the Council to cut down all the salaries was seriously suggested. Principal Ramsay had been trying for some time to obtain that Government support which was so tardily granted in the end. The following letter from Thompson, written in June 1884 to the Principal of the Newcastle College, shows the state of affairs at that time:

"DEAR PROFESSOR GARNETT,

"I have been asked by the Principal of our College, Dr. Ramsay, to communicate with you upon a question that is a little agitating us just now. You are aware, I suppose, that our College is (and always has been) on a very precarious financial footing, and that our expenditure exceeds our income by several hundred pounds every year.

"This, obviously, must come to an end sometime, and the matter is so far critical that there is a serious proposal on the *tapis* for reducing our not-too-large salaries all round. We have no endowment of any kind. The Oxford grant is reduced to £200 a year, contributed from private sources with no promise of perpetuity, and the Clothworkers' grant of £300 a year is not too certain to continue. Under these circumstances the question of applying to Government, as the Welsh Colleges have done, for Imperial assistance has cropped up.

"The opinion of our Council is, however, that Bristol asking alone would have no chance of success in Parliament : but that, if such a demand came at once from all the English colleges of kindred type, or at any rate from those of them that are not substantially endowed, such a united demand could not be neglected.

"Our Council has therefore determined to feel its way by taking the preliminary step of communicating in an unofficial way with the authorities of the kindred colleges. This is how I come to address you in the present instance. Do you think that the Newcastle College would join with us in an appeal to Government for a Royal Commission to inquire into the facilities for higher education afforded by the University Colleges of English cities ? "

Dr. Garnett replied at once that he would not only bring the subject before the next meeting of the Council of his College, but also before the Nottingham Committee.

Meantime another proposal before the Bristol Council, to drop the Arts side of the University College, also excited great wrath among the staff, and led to the following letter from Thompson, written in June to a member of the Council :

"DEAR CANON PERCIVAL,

"The Principal has shown me the outlines of a scheme for recasting the financial arrangements of University College. As I have given myself time to consider the

question, I think I cannot too early take the opportunity of saying that it does not commend itself to my judgment.

"If carried out it will effectually cripple the literary side of the College, and for that reason, if for no other, I should regard it as disastrous to the prospects of the College. We owe it to the influence of Oxford, and I believe very largely to yourself and the Master of Balliol, that our College has not been confined in its aims to being merely a Science College. To draw back now would be little less than fatal. Further than this, the scheme runs counter to the entire policy pursued by the College of late years towards members of our staff, to whom it has been our policy to give as good a guarantee as possible, leaving the fluctuating chances of shares of fees as a minor item.

"Were the change adopted in my own case, I think it would probably not make a difference of £50 per annum either way. But I am quite certain that it could not have the effect of inducing me to throw myself any more heartily into the College work. Some of my colleagues it would effectually drive away to seek their bread elsewhere, and some whom I should be most unwilling, for the sake of the College, to lose. I do not think, though I am speaking only from my own opinion, that the scheme would be acceptable to any one of my colleagues, and I sincerely hope it will not be pressed either now or at any future time. I do not say that the scheme might not work, had it been propounded at the beginning of the work of the College. But it will not, I am sure, bring anything but disaster to adopt such a course at this stage."

Although Thompson received little encouragement in his efforts to awaken public opinion to the needs of the College, a long letter from him to the *Western Daily Press* in October 1883 pointed out the necessity of Government assistance to English Colleges, such as was granted to those of Scotland, Ireland, and Wales. It was entitled, "Why not for Englishmen?" and created considerable interest and correspondence. But he was told, "Mr. Mundella is dead against the idea of endowing English Colleges, and so will the Treasury be, you may be sure."

The staff of the College held a united meeting of protest, but the obnoxious scheme for readjustment of salaries was

persisted in. The following letter to his mother, written by Thompson at the end of the Session of 1884, shows his feeling on the matter :

“ The time seems drawing very near when work will be over and my American trip begin. I have to go to Liverpool next week to preside at a meeting of the National Association of Science and Art Teachers on Saturday afternoon and evening. But I shall not have a spare hour, otherwise I would try to sleep one night at Settle. I shall, however, come for a peep before I go to Canada ; probably about July 12th or 18th.

“ The babies are well and lively. The Conference (annual) of Head Mistresses is going on this week in Clifton. Janie’s old schoolmistress, Miss Jones of Notting Hill, is staying with us. We were at the *Conversazione* at the Clifton High School last night.

“ College affairs are drifting from bad to worse. I fear the Council are simply letting the whole thing slide ; for they are doing absolutely nothing to put the College on a better financial basis. Money is being given to other colleges all round ; we cannot get any. No legacies and no endowments have yet been given us since we began. The Professors held a meeting this week to protest against the inaction of the Council. Whether this will produce any good result remains to be seen. This kind of thing going on is very unpleasant. It makes one all the more sorry that none of the London posts have fallen to my lot.”

The London posts referred to in this letter were appointments under the City Guilds Institute in connexion with the founding of their two Technical Colleges in London. Thompson had applied for the post of Directing Secretary, and later for that of Professor of Physics at the Central Institution.

The Technical College, Finsbury, the first to be started by the City Guilds Institute, began with evening classes in 1879. The day training classes for engineers and chemists began in 1883, when the present building was opened. Its foundation stone had been laid by the late Duke of Albany in 1881. The three chairs of Physics, Mechanical Engineering and Chemistry were held respectively by Professor W. E. Ayrton, Professor John Perry, and Professor H. E. Armstrong,

Mr. Philip Magnus (afterwards Sir Philip) being the Directing Secretary.

Thompson's name was well known to many members of the City Guilds Institute, and so was his work on Technical Education; he had been asked to draw up, for the use of the Committee, a scheme for a Central Technical College, which was practically embodied in the final scheme adopted by them for their new Central Technical College, which was opened by Albert Edward, Prince of Wales, in 1884.

The following communication was therefore sent to him in January 1885 by Mr. Magnus as soon as Professor Ayrton of the Finsbury College was elected to the chair of Physics at the Central:

"The Members of Sub-committee C are about to consider the recommendation to the Executive Committee of the names of two or more gentlemen as candidates for the post of Principal of the Finsbury Technical College. The Principal will be expected to take the general management and superintendence of the College, and to act as Professor of one of the Science Departments. He will be required to give his whole time to the work. The Committee are prepared, under certain circumstances, to offer a salary of as much as £800 a year."

Professor Thompson did not hesitate long in deciding to send in an application for the new post. Among those who gave him testimonials were Canon Percival, then President of Trinity College, Oxford, Dr. B. Jowett of Balliol, Professor Alfred Marshall, Professor of Political Economy at Cambridge, Mr. Albert Fry, the Chairman of University College, Bristol, and his kind friend Dr. John Hall Gladstone, F.R.S. Canon Percival wrote to him personally:

"Though I shall be very sorry to see the Bristol College lose your services, I should feel it my duty to give you a very hearty support in any way which you might suggest as likely to be most effective, should you stand for this."

In his testimonial he wrote:

"Mr. Thompson is so well known that I suppose he can hardly need my testimony, but having had constant oppor-

tunities of observing his career ever since he became Professor at Bristol, I can only say of my own experience that he is not only a remarkably brilliant lecturer, and a writer of excellent textbooks, but that he has given much study and attention to the best methods of Technical Education, both at home and abroad, and has written some of the most interesting things that I have ever seen on this subject. Mr. Thompson is, moreover, a man of great energy and activity, and would be ambitious of making any institution under his direction thoroughly efficient in all its departments."

From Jowett he received the following :

"You are welcome to refer to me in your candidature for the Finsbury College. If it were not likely to be so great a loss to us at Clifton, I should heartily wish success, either to you or Professor Ramsay.

"Yours sincerely, B. JOWETT."

The post was applied for by seventeen candidates, many of whom were known to Thompson, among them Dr. William Ramsay and Professor Barrett of Dublin. The latter, when he heard that Thompson was a candidate, very generously wrote to withdraw in his favour, and used all his influence on his behalf.

To him Thompson wrote on February 17th :

"Your most generous action in withdrawing your candidature in my favour will, I believe, practically make my election secure. I will let you know how things stand after Friday next ; but meantime I know not how to thank you in words.

"It is entirely untrue that I have been canvassing in the City ; and it is a great shame of X to be circulating the reckless and untrue statements that have been so freely set going of late in this matter. This instance is only one of a large number that have come to my knowledge. It is a great pity. With the most grateful feelings. . . ."

• The list was shortened down to six candidates, and when the election took place, Thompson had a large majority, nineteen out of twenty-six voting in his favour.

He received many letters of congratulation. Sir Frederick Abel, with whom he had been associated in the judgment of the Safety Lamps, one of the Committee, wrote :

“I congratulate you sincerely upon your success, which was gratifying to me personally. I hope and believe that the appointment is one in every way congenial to you.”

Dr. Gladstone wrote :

“I am very glad indeed to hear that you have been elected. The right man in the right place. I have no doubt there is good work before you in London, and that you will do it with all your heart.”

Silvanus Thompson was in his thirty-fourth year when he became Principal of the Technical College, Finsbury, and this was the scene of his labours for over thirty-one years, as he still held the appointment at the end of his life.

The college building is situated in Leonard Street, a dismal back street off the City Road and behind Finsbury Square, from whence it derived its name. The neighbourhood is dull and depressing, but it has its advantages in being very central for trams and railways from the outlying suburbs of London. The college was a dingy-looking stone building in harmony with its surroundings, and during Thompson's time there, was considerably enlarged by the addition of a huge wing for the engineering department.

As Professor H. E. Armstrong also left Finsbury at the same time as Professor Ayrton, in order to take up the chair of Chemistry at the Central Institution, Thompson had the pleasure after Easter of welcoming as his colleague his old friend Raphael Meldola, who had already attained to fame as the discoverer of the beautiful aniline dyes known as Meldola greens. With him he always had the most harmonious relationship, and their friendship, founded on many common interests, lasted to the end. His other colleague, John Perry, F.R.S., the Professor of Mechanical Engineering, had held his post in the early days of the foundation of the college, and had been intimately associated with Professor Ayrton in the pioneer work of forming an Electrical Engineering Laboratory. Electrical science

at that time had hardly yet been recognised as a branch of engineering, and a few brilliant young men were anxious to get it established on a thoroughly practical basis. Thompson, by his Cantor Lectures and published works, had already very largely contributed to the attainment of this aim. With him Professor Perry co-operated most loyally, and the relations between the two departments were all such as to promote the welfare of the college. Two years after they had begun to be colleagues, Professor Perry wrote to Thompson in March 1887 :

“Your letter of the 11th inst. is another evidence—if evidence were wanted—that in working for the good of Finsbury, the details of your method of working are as free from meanness as the object itself is. I agree to your proposal (as you see by my programme for next year) after a large amount of mental debate.”

Thompson's appointment took place early in March, and he removed to London that month in order to prepare to take up his duties after the Easter vacation. He was fortunate in being able to retain the services of his former assistant, Mr. E. A. O'Keefe, who also left Bristol, and was appointed assistant at Finsbury. Having acceded to the request of the Council of the Bristol College, to continue his work there until the end of the Summer Session, Thompson had a very strenuous three months at the beginning of his career in London.

The work of Principal and Professor at Finsbury was always strenuous, indeed too strenuous, because the college had departments for day and evening students, and even the Principal was expected to give one or two evening lectures every week from October to May, with a very short vacation at Christmas. During many sessions Thompson was giving ten lectures per week during the winter months. For the day students, who numbered over two hundred, there were courses in Physics, Electricity, Chemistry, and Engineering. The object of the training as set forth in the prospectus was the education of—

I. Persons of either sex who wish to receive a scientific

and practical preparatory training for intermediate posts (as, for instance, foremen or managers) in industrial works.

II. Apprentices, journeymen, and foremen who are engaged in the daytime, and who desire to receive supplementary instruction in the art and practice, and in the theory and principles of science connected with the industry in which they are engaged.

III. Pupils from middle-class and other schools who are preparing for the higher scientific and technical courses of instruction to be pursued at the Central Institution.

The college therefore fulfils the functions of a finishing technical school for those entering industrial life at a comparatively early age ; of a supplemental school for those already engaged in factory and workshop ; and of a preparatory school for the Central Institution.

The department for the evening classes comprised each of the subjects of the day classes adapted to the requirements of the different types of student, with the addition of a large Art Department, and various Building trade classes, Cabinet-making and other Art industries.

When Thompson came to Finsbury there were only two women day students taking the courses, Miss Hertha Marks (afterwards Mrs. W. E. Ayrton), a distinguished student in Physics, and one other, a chemical student. There were never any more women day students during his time, as the accommodation for them was so inadequate. Even the men students had no common-room or lunch-room, and were obliged to go to restaurants during the lunch hour.

Finsbury College was adapted most rigorously for work, and work only, and the numerous evening students of both sexes simply came for their classes, but had no corporate feeling or attraction to the place, such as was felt at the more popular Polytechnics which came into being in later years, and proved such a boon to those whose education was lacking in many respects.

The students desiring to enter the day courses of Physics, Engineering or Chemistry had to pass an entrance examination in mathematics and English subjects, particular stress

being laid on composition and précis writing. There was no limit of age above fourteen, but it was rare for anyone below sixteen to be able to pass the entrance examination, and as there were for many years more students applying than there was room for, it became in a way competitive, for those who did best were admitted by preference.

Thus it happened that occasionally the students included a few who were older, who had previously gone through some engineering or workshop training. Thompson frequently found that such students did extremely well. The college did not prepare its students for any outside degree or examination, but at the end of the courses of either Electrical Engineering, Mechanical Engineering, or Chemistry, certificates of proficiency were granted to those who had passed the final examinations up to a certain standard. Within a few years of the establishment of this system, those students who had gained certificates were able to obtain good posts without serving any apprenticeship, paying any premium, or taking any University degree. Thompson's insistence that the training for the industries must be essentially practical became so well known that to have been under him at Finsbury was an asset to many of them.

In October 1887, at a time when there was again great public discussion on Technical Education, and at the end of his first complete year's work, Thompson printed an account of *The Present Operations of the Finsbury Technical College*. After a historical summary of the starting of the College, he gave a survey of the scope of the work which had been and might be achieved in it. During 1886 the college had been attended by 156 day students and 912 evening students. But after a few years the numbers increased considerably. With regard to the educational methods pursued he wrote :

“The education given in the college presents several points in marked contrast to an ordinary college education. The laboratory, the workshop, and the drawing office take up the main portion of the student's time. For every hour in which the student is being talked to in the lecture-rooms,

there are two hours in which he is instructing himself by actual work.

“Textbooks are almost unknown ; the students acquire their facts and draw their inferences not from books, nor from the *ipse dixit* of the teacher, but from the things themselves. The results of this scheme of instruction are briefly this : that the students who have followed out their course enter industrial life under much more favourable conditions than otherwise they could have done. They pick up in the shops in two or three years more than they could have done in five or six years under the old apprenticeship system.

“In many cases they enter at once as improvers ; their college training stands them in better stead than an expensive premium, because it fits them to enter, not as premium pupils, but rather as workmen, and they gain the confidence of older workmen as premium pupils very rarely can do.”

The Evening Classes admitted many of the students at half fees as apprentices ; some were not much over fourteen years of age, others considerably older. There were no entrance examinations to restrict admission, and the attainments of the students were very varied. The subjects of Electricity and Magnetism and others connected with Electrical Engineering, such as Dynamo Design, Electric Bells, Electro-plating, when inaugurated by Thompson, brought crowds of eager young men to the college, and later on courses on Technical Optics attracted men from great distances, some even from Nottingham and Leicester who had to travel back by night in order to be at their work next day, so keen were they to profit by his remarkably lucid and clear explanations of complicated optical phenomena.

No actual trades were taught in the college, the nearest approach to trade-teaching being the practical instruction given in the Plumbing and Metal Plate classes. This instruction, though more than mere handicraft, was regarded as supplementary to apprenticeship, not as a substitute for it. In these classes the aim was to give instruction in the application of the principles that underlie the various

processes. In every case the classes were placed under instructors who were conversant with trade usages and terms, having themselves worked in that trade. This was in Thompson's opinion an absolutely essential qualification for the teachers of the "Trade Classes." In the Applied Art Department he took a very great interest. There were life classes both for painting and modelling, and some distinguished men received their first instruction in the Finsbury Evening Classes.

One subject which greatly attracted Thompson was the electro-plating, which was taught for thirty-five years by Mr. Rousseau, an extremely able instructor. The electro-deposition of metals was thoroughly investigated by Thompson; he tried many experiments, and succeeded in inventing a mode of electro-plating with cobalt which produced a beautiful untarnishable silver-grey surface of great use for decorative purposes. He sent a paper describing this discovery to the Royal Society in 1887, which was communicated by Dr. G. Carey Foster, F.R.S., and also took out a patent for the process.

In his home at Hampstead he had for more than twenty years an overmantel executed in brass and plated with cobalt which never tarnished, and was often greatly admired. He also had a portrait model made of William Gilbert, author of *De Magnete*; this too was executed at the college and plated by the cobalt process. At one time the Metal-work classes attracted two gold medallists from South Kensington to attend at Finsbury for the purpose of studying that art. Some of the early work of Mr. Gilbert Bayes, R.A., was executed in this department, while he was still a student in his teens, and before he had begun his career at the Royal Academy. Among these early works was a portrait group of Thompson's four little daughters, to whose nursery at Hampstead the young artist was a welcome visitor on Saturday afternoons.

After a visit paid to Italy in 1892, Thompson introduced another artistic handicraft into the curriculum of the Art Department, that of enamelling on metal as carried out in Venice and other Italian towns. He was able to find just

the right man as instructor, and under Mr. Alexander Fisher a most successful and enthusiastic class was carried on for several years. Some of the students—as, for example, Mr. and Mrs. Nelson Dawson—achieved remarkable results and set up schools of metal-work themselves. Thompson, of course, tried his hand at the new form of Art, and succeeded in producing some little souvenirs of his own design. During that same Session 1892–3 he gave a Special Course, of three lectures on the electrical principles underlying the process of Electro-deposition of metals.

In spite of the many administrative duties which fell upon the Principal of a progressive and active Technical College, such as Finsbury became under Thompson, he was always at work devising better experimental means of bringing within the mental grasp of his students the very difficult problems presented by the study of Electrical Engineering. As an original investigator himself he stimulated his senior students to work out original problems and designs for themselves. As years went on there grew up round him in the college groups of young men who were eager to act as his assistants, and who many of them passed on to take prominent positions themselves. To mention a few associated with him in the earlier years, Dr. Walmesley, Mr. O'Keefe, Professor Miles Walker, Dr. Dennis Coales ; all have become in later years heads of Colleges or of Technical Departments in different parts of the country.

During the vacation preceding his first Session at Finsbury, Thompson was fully occupied in preparations, and there was no possibility of taking a holiday, hence the following letter to Oliver Lodge, then at the British Association Meeting, dated September 7th, 1885 :

“DEAR LODGE,

“I am taking the liberty of addressing to you a small parcel which contains some polarising prisms which I wish to have shown to Section A. Much to my regret I can't come in person : but will post to you by later post the paper describing them, and also some sheet diagrams explaining how these prisms are cut. I hope you will have a good time, and will keep the ball rolling of making Section

meetings productive of better results in the way of fuller and more exhaustive discussions. We must get *frictional* production of currents next in hand : it *must* be explicable. Fleming is going to be with you : I think he's on the war-path on Electrolysis. So is Armstrong *more suo*.

"Has Sir W. Thomson given in yet ? If not, shake your fist at him again : he must cave in."

During the Christmas holidays he wrote to the same :

"Apropos of your last circular (You've hit the way to make us work !) and your own experiments, may I make a suggestion—namely, that you fill your (HCl) tube previously with a *jelly* to which a little HCl has been added ? This will get rid of many difficulties arising from currents. But probably you have thought of this before. I think we ought to make a set of special jelly experiments—*e.g.*, a jelly Daniell cell—and see how the presence of the jelly affects action. If you think well of it, I will have some experiments made on this matter."

To this Professor Lodge replied :

"No, I had not thought of jelly in this connection, but it's an A1 idea.

"Please try your jelly Daniell ; I think it must lead to something. It's very Guthriesque.

"I shall try a jelly tube very shortly. Best wishes for New Year."

Thompson wrote again to the same, early in 1886, commenting on an article in the *Philosophical Magazine* :

"I am delighted to see that when 'polemick' is the right thing, you are not afraid to polemicise. What reply there can be I can hardly conceive. I'm the more delighted because I find you have rejected the specific heat of electricity so completely. Now that you have brought down a sledge-hammer of common sense upon the thing I shall be surprised if the misleading analogy does not die out. I shall be very curious to learn what Sir W. Thomson says.

"I wish I could report any progress on the few things I am hoping to do. All my days and nights are going on administrative work just now, and on devising much-needed lecture illustrations. I got some jelly ready to make a

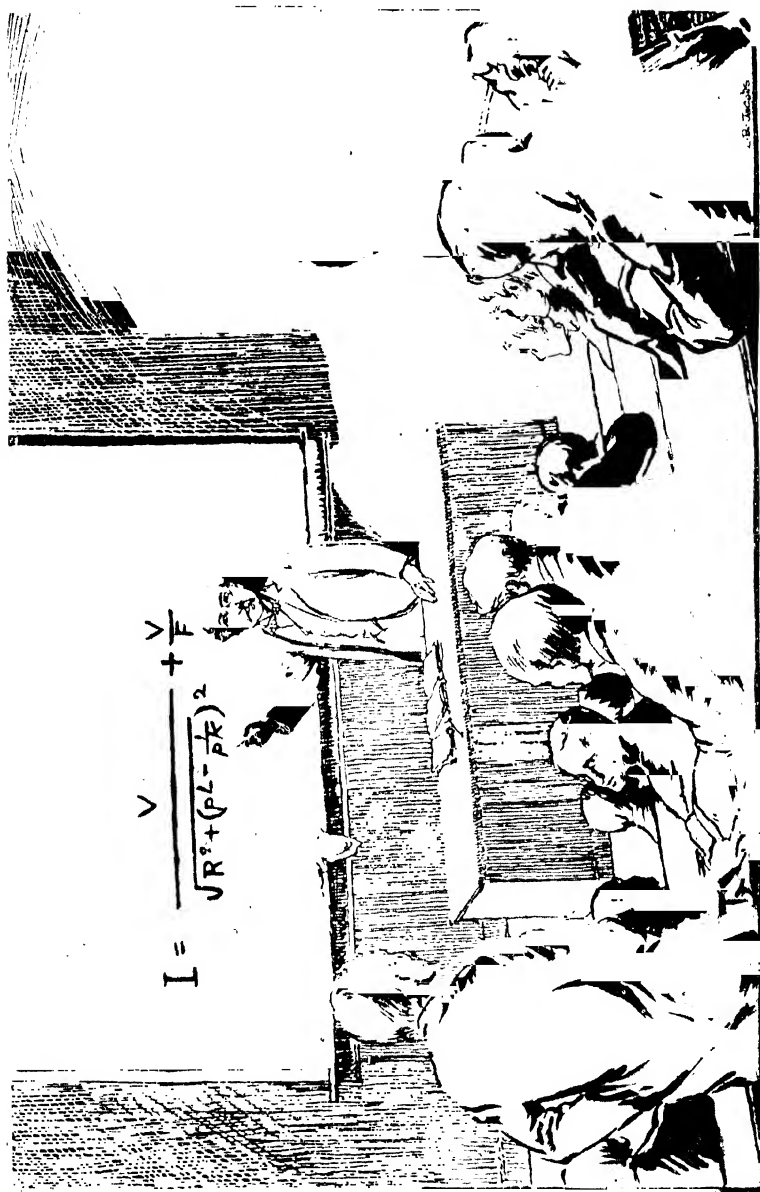
‘jelly Daniell.’ It developed swarms of bacteria and other organisms before I could even begin to use it. But I shall try again.”

Many of the new students who came to Finsbury had received little or no training in the art of making notes for themselves of lectures or of laboratory work. Thompson considered this part of their training to be of such great importance that he frequently held a “note-taking” class at the beginning of a new Session, and would give up part of his Saturday morning to drilling them in the art of making notes which would be useful to themselves in after life. He often told the new students :

“I want you to work hard at your notebooks in the different subjects. You must make them so thoroughly your own that they will be more useful to you during the next twenty years than any textbook you can buy. Keep a separate notebook for every subject, and so build up a library of your own records of your own experiments. Of course you must have—and read—other books for reference, but your own will prove so valuable that you will go to them in future years if you want to look things up. I do not know where I got the notion, which I never thought of for myself, but to this day I have notebooks of forty years ago, and find them useful.”

Thompson was very strict with first-year students; if they wasted their time, were indolent and unpunctual, showed no purpose in their work, and failed in the first year’s examinations, he would frequently advise their parents or guardians to take them from the college, and put them to other work. In a very few cases they were allowed to repeat the first-year course.

In order to help his students to get a grasp of the Integral Calculus, a branch of mathematics absolutely essential for the training of a mechanical or electrical engineer, he invented a new way of presenting the subject which was used for many years in the college. At last, in 1910, he published this in the form of a small volume entitled *Calculus made Easy*, by “F.R.S.” It was brought out by Macmillan’s, and the secret of its authorship was faithfully



CARICATURE PORTRAIT OF SILVANUS P. THOMPSON LECTURING AT FINSBURY COLLEGE.

kept until after the death of the author. It was written in a very amusing colloquial style, which raised the ire of some of the serious teachers of mathematics who objected to the subject being treated as a joke, but its tremendous success showed that it met the need of students. In the Prologue, he says :

“ Being myself a remarkably stupid fellow, I have had to unteach myself the difficulties, and now beg to present to my fellow fools the parts that are not hard. Master these thoroughly, and the rest will follow. What one fool can do, another can.”

In the Epilogue he says :

“ There are amongst young engineers a number on whose ears the adage that, what one fool can do another can, may fall with a familiar sound. They are earnestly requested not to give the author away, nor to tell the mathematicians what a fool he really is.”

The students who knew the secret kept it carefully. The reviewer in the *Athenæum* said :

“ It is not often that it falls to the lot of a reviewer of mathematical literature to read such a gay and boisterous book as this ‘ very simplest introduction to those beautiful methods of reckoning which are generally called by the terrifying names of the differential calculus and the integral calculus.’ As a matter of fact, professional mathematicians will give a warm welcome to a book which is so orthodox in its teaching and so vigorous in its exposition.”

Another critic wrote :

“ Not only is this book an admirable introduction to the calculus, but it is more than that. It is a broad philosophy of life, and as such will endear itself to all men who have been through Part I *Mechanics*. It is worth buying for the jokes alone ; and as for its mathematics, the principles of differentiation and integration as presented by the anonymous author would be intelligible even to a Botany man. All textbooks should be written in this style.”

Many appreciatory letters were sent to “ F.R.S.” through

the publishers, and his colleague, Professor E. G. Coker, F.R.S., wrote :

“ I am very pleased to hear that your little book on the Calculus is likely to be available for general use. As you know, I have been teaching the elements of this subject to the junior classes here for some years, and I do not know of any other book so well adapted to give fundamental ideas. One of the great merits of the book is that it dispels the mysteries with which professional mathematicians envelope the subject. I feel sure that your little book, with its common sense way of dealing with elementary ideas of the calculus, will be a great success.”

The book had to be reprinted three times during the year after it was published. In 1914 a new edition, with errata corrected and a considerable number of new examples added, appeared. This was reviewed in *The Mathematical Gazette* by Professor Alfred Lodge, a distinguished mathematician, brother of Sir Oliver Lodge. His criticisms were somewhat severe, but he wrote :

“ The work is very sound as a whole—and it is not surprising to see that the book has met with a good deal of success, as it carries the practical student to a very useful point.”

In 1916 Professor Alfred Lodge somehow discovered the authorship, and wrote to Thompson for confirmation of the fact, promising to preserve the anonymity and saying : “ It was a courageous book to write, and I congratulate you on its great success.”

Sir Oliver Lodge wrote :

“ MY DEAR SILVANUS,

“ You know that book *Easy Lessons in the Calculus*, I have concluded that the book is by John Perry, but recently I have heard it attributed to yourself. I do not in the least think that that is true, but perhaps you would not mind sending me a postcard either of denial or acceptance, for evidently the anonymity is not carefully preserved.

“ Yours ever,

“ OLIVER LODGE.”

After the death of the author the book was published in his name, and is still being largely used, both in this country and in America.

In 1893 the Director and Secretary of the Municipal Technical School, Manchester, Mr. J. H. Reynolds, writing to Thompson about a Conference on Technical Education which was being held there, says :

“I am very sorry indeed to learn from your letter that you are not able to be present at the Meeting. I think you would have helped to put the objects of the Meeting on a sound basis. I am with you entirely in your desire that the organisation should be educational rather than professional.

“Finsbury is to me the prototype of what Technical Schools should aim to be. In saying this I refer to the organisation, method, and aims of that school, and I have striven as far as circumstances permit to realise these conditions in the Manchester School, but very few indeed of those who will meet to-morrow control schools of like aim.”

Like every other college, Finsbury had, of course, its Old Students' Association. In early years they used to give a *soirée* for the students and their friends, which used to overflow into some of the rooms of the Cowper Street School behind, kindly lent for the occasion, a covered way being erected across the playground of the school to connect the two buildings. When the old students began to be numbered by thousands, this was given up, and an annual dinner was instituted at which the Principal almost invariably presided. There was also an Old Students' Magazine, with a portrait (somewhat of a caricature) of Thompson on the outside cover. There were smaller societies of Chemical Students and Electrical Students which maintained the *esprit de corps* of their own departments.

The following extracts from a letter from Professor William Ernest Dalby, F.R.S., who succeeded Professor Perry in the chair of Engineering, gives an idea of the position which Thompson had reached with staff and students after nine years' administrative work :

“I was appointed to the Professorship of Mechanical Engineering and Applied Mathematics at Finsbury in 1896. The Principal was to everyone in the college ‘The Doctor.’ His influence over the students was wide and deep. Probably every student who entered the college knew him through his writings. It is certain that every student when he left the college was affectionately devoted to him, and knew him as a friend. It was only a few weeks ago that I ran across an old student of his who considered that the greatest good he carried away from him was not what he learnt in the lecture-room and laboratory, but guidance in his theological difficulties, which helped him to a rule of life which he has practised consistently.

“No doubt this same experience could be multiplied by many others. The devotion of the students to the Doctor was shown enthusiastically when he appeared on the platform during the one soirée of the year. All must remember the wild and enthusiastic greeting he always received.

“He was helpful to students and staff in every way one man can be helpful to another, and I am sure letters of acknowledgment from old students, of help and guidance received, would be enough to fill a book.”

Professor Dalby left Finsbury in 1904, being appointed to the Professorship of Civil and Mechanical Engineering at the then Central Technical College, now a part of the Imperial College of Science and Technology. It was during his time, and owing greatly to the success of his department, that an anonymous donor offered £10,000 towards an extension of the college if the Institute of the City Guilds would give £20,000 ; this offer was accepted. The new Engineering wing was opened in October 1907 by the Lord Mayor, and the extension of the building provided incidentally much better accommodation both for the Principal and for the Art Department.

Professor Ernest G. Coker, who succeeded to the chair of Mechanical Engineering, was also a very friendly colleague ; he was engaged for some years in a series of researches on stresses in materials such as are used in engineering. He devised a means of showing how they occurred by executing models in transparent celluloid, examining them by polarised

light. These researches, which gained for him the Fellowship of the Royal Society, were deeply interesting to Thompson. Professor Coker wrote of him :

“To his artistic instinct experimental work on light appealed with especial force, and it always remained a dominant attraction. His knowledge of this branch of science, in fact, was quite as encyclopædic as in the electrical field, and one could go to him, as I often did, with some perplexing question, perhaps on polarisation phenomena, or an allied topic, and find in him a mine of information. Form and colour especially appealed to him, and he revelled in the gorgeous displays which this kind of work afforded, and to which he contributed many new and original experiments and ideas.”

It was the habit of the Principal to give every year an address to the new students. On one occasion some of his assistants desired to preserve one of these addresses, and had it taken down in shorthand. It has since been published in a Memorial Number of *The Old Students' Magazine*, with notes by Mr. Robert P. Howgrave Graham, who was associated with him as student and assistant for seventeen years. The addresses were of course varied, and altered somewhat in character with the development of the college ; in 1885 the note was “Finsbury going to be a success.”

“References to the Old Students Association, to the Literary and Debating Societies, and to all the athletic clubs, rowing, swimming, running, cricket, and football, brought these under the notice of the new students, and showed his enthusiasm for everything which tended to provide students with common aims, or to enlarge the scope of their interests. In 1895, when he had completed a decade of hard and successful work, and felt some pride in its fruits, he faced a room full of new students, to whom he spoke of the Inventors, Consulting Engineers, Discoverers, and Big Factory Managers who had sat there before them.

“He used to tell them, ‘What one fool can do another can,’ ‘Genius is the genius to work hard,’ ‘We can hope to be at least happy in that we found our work in the world and did it.’

“The spirit and ideals which governed his intercourse with students and others who worked under him at the college are typified by a small shield which hung in his room there, emblazoned with a line from Chaucer’s description of the poor parson: ‘If golde ruste what shall iren do?’ Finsbury records certainly show that some at least of its students carry away enough of its atmosphere to save them from rust, and they will surely remember with ever fresh gratitude the untarnished gold in the character and teaching of their old Principal. His wonderful memory is well known to those who have left the College as youngsters, and on their return after long years—responsible, much changed, and perhaps bearded men—have received his greeting by name and initials—perhaps even by date and department. His special memory for faces and persons was partly the outcome of his keen interest in the welfare of his students, and was valuable in the preparation of the annual lists which show their subsequent occupations. He was delighted when anyone enabled him to correct or amplify the printed proof which always lay on his table, and though its revision was a labour of love, it was by no means a light task, since old students have not always kept the College informed of their movements. In the last year or two of his life, he complained that an occasional name in the long list carried with it no memory of its owner, and felt this to be a sign of advancing years; nevertheless he retained sufficient mental vigour to excite the envy of many an ordinary man in his prime. . . .

“And now that he has gone, our thoughts turn from the past to the future influence of his life and work. Has his ‘Quest for Truth’ been consummated or merely ended where he left it, or is he still exploring new and strange paths, nearer to the light, with clearer vision and fewer limitations? Whatever may be the answer of the individual, we know that the Doctor’s philosophy and teaching had a profound effect which will long survive him, helping students, scientific workers, and engineers for many generations. The more personal and human side of his character will exert its influence at least while any Finsbury men who knew him remain alive. Numerous letters from them have been preserved among his correspondence, and show a depth of affection which many more have felt without giving it definite expression.

“Past students come and go across the world, returning

from time to time to see how things are at the old place in Leonard Street, and long experience has shown that their first desire has almost invariably been to see the Doctor or to hear news of him."

The address to new students which is printed in *The Memorial Magazine* is too long to quote in these pages, but the last paragraphs sum up a good deal of its teaching :

"Finsbury students have a reputation for hard work, for not being afraid to take off their coats or to get dirty, and for avoiding running after degrees merely for their own sake. We have had to make our own reputation, and though twenty-five years ago Finsbury had not begun to be known, it is different now. A little while ago I was at the Exhibition at Turin, and met two old students who promptly invited me to dinner. In Switzerland more recently I saw at least one old student, and at Breslau, though I did not see an old student, I saw a man who employed two. From China to Peru there are old Finsbury men, and one is the chief engineer at Shanghai dockyard at the present time. Many of these past students come back here now, for they have old friends to see and old recollections to revive by visiting the College, and they know that we are always glad to see them. I can never be satisfied unless the students who go out into the world keep up the reputation which has been won for the College by the quality of the students who have already gone out. It is a reputation not founded on air, but on something much firmer. It is a most precious possession for us, and a thing of which I think all of you should also be proud.

"Make it your business to live up to it, to add to it, and if possible to excel in all things which you undertake.

"For the rest let each of you try to maintain the high standard of conduct which has been upheld here in the past, avoiding all that is contrary to manliness and delicacy of thought and feeling, and acting together for the promotion of all that is really worth having and doing.

"In this way you can build for yourselves on a sure foundation, not only as engineers, but as men."

* Finsbury College attracted to its laboratories men of many nations besides the young Englishmen who were

afterwards to be found in every country of the globe : there were Belgians, Germans, Swiss, Hindoos, Chinese and Japanese among the students. The letters which came to "The Doctor" from many varied scenes of labour often began, "I know that you like to hear from your old students," and the writers went on to tell their experiences in the various electrical works, some in the States, or in India, or Johannesburg, or Buda Pesth, or Russia.

Many would probably tell of much success, others of having got into the wrong branch of work, and begging for a fresh recommendation. Thompson through his Technical writings was in touch with electrical firms, and would receive letters from them about his old students, often ending up with remarks such as, "If you have any more fellows like X leaving college soon, please send them along to us ; we could do with many such" ; or, "We want a man in our Dynamo design office, or our Drawing office ; can you supply the need ?" At the end of many sessions, every qualified student who was leaving had already secured a post through the college. This was a great boon to students who had no one to push them, and Thompson gained the reputation of being very specially kind to widows' sons. Many students, of course, did not desire posts immediately, and went on for further study in some University in England or abroad.

But these last, too, kept up a correspondence with their former Principal. A Chinese student who went to study at Charlottenburg wrote several times in his quaint English, which became quainter still during his stay in Germany.

In his first letter he says :

"Next week I shall begin to study German language properly in the coming days. I sincerely hope that your example, as well as your kind instructions, have possessed sufficient influence over my conduct. Moreover, I was very happy in enjoying the lectures and experiments when I was in your college. It is my opportunity to thank you for your kind instructions and advice. I am living as you would wish and have taught to live."

Some months later he writes ;

"How are you, Sir? I hope you are quite well in your land. Your instructions profited me very much, even now I am in Germany I always remembered your sayings in Finsbury College. Since I came to Germany having nothing improved but learning German language day after day. In this spring I have entered the Technical High School in Charlottenburg, Berlin, in which I am taking a course of metallurgy, specially for the metallurgy of Iron. Can you recommend me several kinds of chemistry and other universal technical Science magazines?"

"I am much obliged you.

"Yours very respectfully,"

A Spanish student wrote from Huesca, where he had been appointed to take charge of a Hydro-Electric station:

"We have a waterfall 40 kilometres distant capable of furnishing 1,000 horse-power. At the same time I am the agent to the Westinghouse Company for a certain district in this North.

"Dear Doctor Thompson, one of the greatest possible pleasures for me would be to know that you were disposed to a trip in Spain, and to put myself at your orders. I know that in more than one occasion I have been rough, ungrateful, and the like. This was only apparently. The truth is that I keep a most grateful remembrance of my stay in England. People call me here: the Englishman. I cannot forget how indebted I am to yourself."

A Belgian who went from Finsbury to Electrical works at Chelmsford wrote:

"There are many from Finsbury here, Wright, Church, Lewis, Ashton, Sheppard; the two former specially were very kind to me, and made my beginning easy. It is always a very awkward time. I soon found out that, if to come from Finsbury is a recommendation, it is also a cause for hearty welcome, and that in the country as in the city, Finsbury men stick together and are proud of the tie."

The same student afterwards took up the teaching of mathematics, and was associated with Thompson in the revision of some of his mathematical work. Years later,

when he was a married man and father of two sons, Thompson sent him a copy of his *Life of Kelvin*, and he wrote :

“ Your magnificent gift has arrived yesterday, and you may guess that all other business had to be put aside for the rest of the day, while I perused the two volumes—the finest ones in my library.”

One or two of his students named their sons after their revered “ Doctor ” and would send him photographs of the youngsters, and perhaps proudly boast of precocious traits showing aptness for an engineering training.

Thompson’s increasing public engagements obliged him after some years of London life to engage the services of a private secretary. No fewer than seven old Finsbury students served him in this capacity, Professor Miles Walker being the first and also the longest with him. He proved a great help, and assisted in many important researches. After his departure to study at Cambridge, he was succeeded by Dr. Dennis Coales, who also eventually took up the teaching profession ; those who followed all went into engineering posts with different Electric firms after two or three years of the training which work under Thompson entailed. They all became his firm and devoted friends and parted from him with regret.

Some of his other students remained on at Finsbury as assistants in the Electrical department of the college. Mr. Stratten Holmes, who had been with him for many years, wrote :

“ I shall always remember my long association with the late Dr. Thompson, first as a student, and then as one of his assistants at Finsbury ; his interesting lectures and his kindly help and advice in times of difficulty and worry. He will be greatly missed by those who had the privilege of knowing him and working with him.”

Mr. Charles Gorick wrote :

“ It was my pleasure to work for him for fourteen years at Finsbury from the time he was appointed chief, and I



THE "DOCTOR" AMONG HIS APPARATUS.
From a photograph taken by J. Russell & Sons about 1910.

have nothing but pleasant memories in connection with his good and glorious work, more especially of my duties as his lecture assistant. Like many, many more, I feel the loss of so true a friend and kind master, and will remember him always for his most noble manner, for which he was so greatly admired by all those who came in contact with him."

Another wrote that, during all his years as assistant, he had never heard Thompson utter an unkind word to anyone. His extraordinary patience was always a marvel to those who worked under him, and seemed to spur them all on to do their best. His perfect calmness as a lecturer and experimenter was an immense help to his assistants. On one occasion, when he was giving a public lecture to an audience of many hundreds, a small piece of apparatus, which was being used in an experiment in a projection lantern, gave way suddenly, owing to the heat of the lantern. He calmly left the subject, and passed on to other experiments in front of him, while Mr. Walker and Mr. Thomas deftly soldered the apparatus there on the platform, and in about a quarter of an hour he turned and resumed the experiment, explaining what had occurred, and saying that he counted himself fortunate to have assistants who could perform such an operation on a public platform without disturbing the progress of the lecture. The public appreciated the deed, and gave them a round of applause.

The student who worked longest with Thompson, and at the end of nineteen years was still serving him, Mr. Robert Howgrave Graham, wrote that :

"Having found that contact with him brought always increasing love and reverence towards him, may I speak personally and intimately on behalf of a multitude of students—old and present at Finsbury. I once heard a speech given by a rough-spoken past student at a dinner—almost passionately warm and calling forth storms of enthusiasm. He said that : 'The Doctor' was the only name in Finsbury students' hearts, and that all the world over it had only one possible meaning when they met. Finsbury was 'The Doctor' inseparably, and the magic name always warmed a Finsbury man's heart as the name

of a certain and never-forgetting friend as well as teacher. This was no exaggeration."

Another old student wrote :

"I can bear testimony to the reality of the remarkable friendship that existed between Professor Silvanus Thompson and his pupils, a friendship of which the seeds were sown in his 'Opening Address' to the new students, and which grew to be strong and lasting during the happy days at College, where, in his gifted hands, to learn was a recreation. Professor Thompson was popular, but not in the ordinary sense of the word. Our regard for him was of a different and deeper nature. He had no generally accepted nickname. We knew our Doctor for the great man that he was—we knew his talents would have brought him far greater fame had he sought worldly advancement—in a vague way we knew him to be the holder of earnest convictions, which led him to neglect self, and give to us of his best—we each knew him as a personal friend and counsellor. His cheerful word of advice or encouragement, his real goodness of heart, and above all his downright sincerity, drew from us our friendship, regard, and respect.

"As a teacher the Doctor was extraordinarily interesting. I have listened to many lectures on scientific subjects, but I have yet to hear the lecturer who can be compared with him. In Physics and Electricity he had subjects which appeared to give special scope for the application of his talents, but we found that any subject that he touched upon was made to be of absorbing interest.

"Of the Doctor's many qualities I was perhaps most impressed by his honesty—the average 'honest' man was not in the same street! Humbug and hypocrisy, even in their very mildest forms, were entirely foreign to his nature—yet he was a model of tact.

"Shortly before leaving Finsbury I asked his advice regarding my attitude towards my prospective employer, then unknown. In reply to my question, 'Should one address a Works Manager as "Sir"?' he said, 'There are some who wish to be addressed in this manner—I can safely leave you to judge your man!' I do not know that I could have had better advice or that it could have been more cleverly put. I certainly made it my business to judge my man!"

This chapter seems to close fitly with the following lines from a poem by an old student, written in memoriam :

“Great Teacher, thou art gone ! We look in vain
For such a lamp as thine to grace again
The path of learning and its lagging hours,
Showing amid the rocks the hiding flowers.
Thy flame was twofold ; all the world well knew
How thy clear intellect in lustre grew
With passing years, and flinging far its rays
In speech of flawless crystal, lit the ways
Where pilgrims journeyed in the quest for Truth.
We sought it with the eager eyes of youth
To learn how man his wealth from Nature draws
And found the ordered structure of her laws
Like storied architecture, height on height,
Soaring beyond our vision into light
Of Truth yet unrevealed. To thee of old
We came for silver, and thy gift was gold ;
Like thee we found the faith that Knowledge brings
Through ‘ the deep mystery of common things.’ ”

R. P. H. G.

CHAPTER VIII

LIFE IN LONDON, THE ROYAL INSTITUTION. BIOGRAPHY OF
FARADAY. UNIVERSITY REFORM

It was not without considerable regret that the Thompsons left their pretty little home in Clifton in 1885. They had been living among an intellectual and congenial circle of friends whom they knew that they should miss greatly.

They had made many friends among the large Quaker community in Bristol, and visits to the beautiful homes of Lewis Fry, M.P., of Francis J. Fry, who was an amateur scientist, of Albert Fry, who was Chairman of the College, of Thomas Pease at Westbury-on-Trym, of the Wedmores of Druid Stoke, of many members of the Sturge family, were all times to be remembered.

Then there were the friends and supporters of the college, Mr. Joseph Weston, Mr. Samuel and Mr. William Budgett, Mr. Frederick and Mr. H. O. Wills, Mr. Mark Whitwill, Dr. Beddoe, F.R.S., Mr. F. Gilmore Barnett, brother of Canon Barnett, and many other worthy citizens, who in honouring the college extended their hospitality also to its Professors.

Among Thompson's colleagues, Professor and Mrs. Rowley, who lived in a charming house in the Leigh Woods, Professor Main, and Dr. and Mrs. Ramsay, were their most intimate friends. There were also many among the staff at Clifton College with whom there was much in common. After Dr. Percival went to Oxford he was succeeded by the Rev. J. M. Wilson (afterwards Canon Wilson), and Thompson was deeply impressed by his fine religious teaching. Dr. William Tilden (afterwards Sir William Tilden, F.R.S.) Mr. A. M. Worthington (afterwards Professor A. M. Worthington, F.R.S.), and the Rev. Philip Sleeman were scientific friends,

whom he had the opportunity of meeting again in London at scientific gatherings, when old friendships were renewed.

The beautiful surroundings of Clifton held great charm for Thompson, and he and his wife used to take long rambles in the Leigh Woods, to Coombe Dingle and through Shirehampton Park to Pen Pole Point. In two minutes from their home they could be on the Downs, and they knew every cranny where the bee orchis grew or the rocks were covered with the little yellow rock rose, and they often took evening walks across to the cliffs above the Avon. But the joy of being in the midst of the eager progressive group of scientific men at work in London outweighed the loss of the joys of nature so near at hand in Clifton.

The first home in London was in Bayswater, in a dingy row of high houses called Arundel Gardens, the attraction to the house being the large square behind where the children could play. He, and his wife also, had a good many old friends in the neighbourhood. Dr. Gladstone was in Pembroke Square not far off, Sir William Crookes lived on the hill above, and used to be at home to his scientific friends in his library on Sunday evenings, when many a discussion took place. Professor Ayrton lived on Campden Hill, Professor Adams in Notting Hill Square. Afterwards, when Dr. Ramsay came to London, he too chose Arundel Gardens, and later Professor Perry also came to live in the same neighbourhood.

Arundel Gardens, however, proved to be a rather foggy situation, so after five years the Thompsons moved away to a house of their own with a private garden at West Hampstead, then on the outskirts of London, and surrounded by fields, long since covered with houses and flats. Thompson called it "Morland" after his ancestral home in Westmorland, and it was for twenty-six years a meeting-place for a large and varied circle of friends, and its visitors' book is adorned by the names of many scientific men who came to stay in the quiet home.

Not long after coming to London, Thompson was appointed one of the examiners in Physics for the University, and frequently one of his fellow-examiners would come to

stay with him, while they were engaged in correction of the papers. Of these, Professor George Francis Fitzgerald, F.R.S., of Dublin, quite frequently made "Morland" his home while in town. His was a fascinating personality, full of fun and Irish humour. He was some years younger than Thompson, but his snow-white hair and beard made him look years older. The colleagues used to enliven their tedious labours by jokes over the howlers perpetrated by the unfortunate examinees. Another who used to come to London for the same purpose was Professor Poynting of Birmingham. He too was a welcome guest and great friend. Thompson had stayed with him in Birmingham on one or two occasions. Professor O. J. Lodge too paid at least one visit to "Morland."

Thompson soon found that during the winter months, when the evening lectures were in progress at Finsbury, and the meetings of the various Scientific Societies to which he belonged were being held, it was necessary to limit the acceptance of dinner engagements very severely, if he was ever to have any time at home to devote to his writings.

As an official of one of the colleges of the City Guilds, it was almost obligatory upon him to accept a certain number of invitations to dine with the great City Companies, and on these occasions it was often his duty to make an after-dinner speech. He was glad of this opportunity to bring the college under the notice of the wealthy City magnates. He soon gained for himself the reputation of being a very good after-dinner speaker, and at the annual dinners of Scientific Societies he was often called upon to exercise this gift. He was never dull, and although he sometimes made use of such occasions to bring forward some aspect of science which he thought was being neglected, the apt quotation, the flash of wit, always enlivened what he had to say, and carried his hearers along in sympathy with him.

He was still as hard a worker as ever. Professor Barrett wrote to him :

"MY DEAR THOMPSON,

"How wonderful your power of work is ! That was almost the last thing G. F. Fitzgerald said to me—he was

lamenting to me how little he had done, and how many things he had neglected. 'Now, if Silvanus Thompson had been in my place,' he said, 'you would have seen the garden in order, the library books all catalogued, all the references I am looking for tabulated and pasted in a book, and everything else properly done; he has a wonderful power of work and order.'

"Really I am more than grateful to you, and am amazed at the ease and speed with which you have read those proofs. I was sure Clerk Maxwell never said 'cells,' but without actual proof did not like to cross it out. Your letter is just what I wanted, to quote from."

In the midst of his many duties, however, he did not forget his old friends of Bristol University College, and we find in *The Times* in December 1888 a letter on the subject of the English University Colleges which were still struggling along without support from the Government. He wrote:

"SIR,

"It is greatly to be regretted that the Parliamentary Session should have been allowed to close without some protest at the way in which, after the intimation given early in the year by the Right Hon. the Chancellor of the Exchequer, the interests of the provincial University Colleges are still neglected. To a financier who can deal with £50,000,000 at a time, a matter involving only £50,000 may seem paltry; yet to one or two of the English University Colleges, the neglect to provide them this year with the promised pecuniary support may mean a condition perilously near ruin. . . . It is little short of a scandal that not one penny of Imperial funds is given for the support of the higher teaching. I speak with some knowledge, not having yet forgotten my nine years' experience as a teacher in an English University College."

In March 1889 this long due reform was carried out by a provision in the Estimates of the Chancellor of the Exchequer for grants to English University Colleges. The battle was won, though the grants were at first very small.

Soon after Thompson came to London he was proposed and elected a Member of the Royal Institution, which he had so eagerly visited, and where he had so diligently attended

the lectures of Tyndall and Gladstone in his student days, just ten years previously.

The Royal Institution in Albermarle Street is not only famous as a centre of scientific research and glories in having had men like Humphrey Davy, Faraday, and Tyndall at its head, but it is also a most delightful place of reunion for men of science, and those who desire to learn from them. It possesses famous laboratories, two endowed Professorships, several endowed Lectures, an excellent lecture hall which accommodates about 1,200 people, ante-rooms and libraries where members can meet and read and study. Courses of lectures are given on three days of the week, all of which members can attend, and which are open to the public on payment of a fee for the course. On Friday evenings the libraries are thrown open for a meeting of members and their friends only, and on that occasion a special discourse is given by invitation of the managers, by some famous scientific investigator or traveller on the very latest invention or discovery of the day.

This discourse is given in the lecture hall, the chair being taken by the President of the Royal Institution or some scientific man of eminence among the members; it begins at nine o'clock, and is supposed to occupy not more than one hour.

The first time Thompson attended one of these gatherings as a member was on Friday, January 22nd, 1886, and his wife, who accompanied him, jotted down some notes about that memorable evening :

“The first object which attracts attention in the Royal Institution is an imposing marble statue of Michael Faraday, which stands in the entrance hall at the foot of the staircase. He is represented holding in his hand a coil of wire and a bar magnet, by means of which he made the wonderful electromagnetic observations which formed the foundation of the discovery of the dynamo-electric machines. On the staircase which ascends to right and left hang portraits of Count Rumford, the founder, and Sir Humphrey Davy. In the library upstairs were arranged various scientific exhibits which could be inspected both before and after the discourse.

"I was looking forward with pleasure to this lecture, which was to be given by Professor Tyndall, who was so famous as a scientific expositor. The subject was 'Wave Forms.' But such a disappointment! Poor old man, he maundered on for an hour and twenty minutes, repeating himself over and over. He gave us a life of Thomas Young with very little mention of 'Wave Forms' at all. He is a weird-looking, thin, stooping old man with long grey hair hanging from a high, narrow head. He has a decided Irish brogue now and then, and uses curious gestures.

"After the lecture was over the audience strolled out to the library. Going through the anteroom, which is adorned with historical pictures and busts of famous men and Mrs. Somerville, we encountered Professor David Hughes (inventor of the Microphone) and his wife, who is an American.

"He is a hearty old fellow with a shock head of iron-grey hair; he smote Silvanus on the shoulder with his hand and called him 'My boy'! In the library we had a talk with Mr. Crookes (inventor of the Radiometer) and his wife. They live not far away from us.

"With our old friend Mr. Preece we had a chat about the lecture we had just listened to. He remarked: 'When you and I, Thompson, come to that stage, I hope some friend will be kind enough to prevent our making an exhibition of ourselves.' 'Faraday was wise,' said Silvanus, 'to give up at once when he felt himself failing.' 'Ah! but Faraday failed too the last time he spoke here.' 'I never heard him,' said Silvanus, 'I have assisted him at lectures. I used to come here as far back as 1845,' said Mr. Preece. That was six years before Silvanus was born."

During the next thirty years the Thompsons were habitués of the Royal Institution, and were generally to be seen on Friday nights, seated on the right of the lecturer above the places reserved for the professors and officers of the Institution. In later years Mrs. Thompson was also elected a member, and they were often accompanied by one or two of their daughters. The opening lecture referred to above was the last ever given at the Institution by Professor Tyndall, once its brilliant resident professor. He was succeeded by Professor James Dewar, F.R.S. (afterwards Sir James Dewar), who with his wife resided in the rooms above the Institution, which they adorned with most lovely

tapestries, carvings, and other works of art. Here an inner circle of scientific friends used to meet after the Friday discourse to enjoy their kind hospitality and continue discussions of the lectures and new discoveries which had just been described.

The Friday night lectures often made landmarks in the public knowledge of scientific phenomena. After a few years Thompson was asked to give accounts of the latest discoveries on some line of research in which he was interested. The first in 1889 was entitled by him "Optical Torque."

Thompson always considered that a Royal Institution audience on Members' nights was the most difficult one to address of any that he came across. It was not possible to start off one's subject on a purely scientific basis, and not recognise that there were always many present who knew little or nothing of science, so these had to be introduced, as it were, to the previously known facts which led up to it. Then there were nearly always sure to be some present who knew as much or perhaps more of the subject than the lecturer himself; for these must be prepared new and ingenious experiments, so that they too might find something of interest. In his lectures to this audience Thompson was successful to a high degree, and he generally had a very full house.

After his first, he received from his old Clifton friend the Rev. Philip Sleeman, who had been present, the following letter :

"DEAR DR. THOMPSON,

"I send a few lines to offer my congratulations upon your discourse at the Royal Institution. Judging by the remarks which I overheard, I think your audience was very much pleased. I enjoyed it greatly, as you may suppose, and should have liked to have stopped the clock, so that we might have had rather more of it. I hope you will be able to spare me a copy of the usual 'Abstract' when you receive it. I half expected to see the lecture in *Nature* last week. Your use of the string to show the polarisation of vibrations was most excellent, and also the radial sector, etc., to show the effect of rotation of the

plane of polarisation. These were both of them, doubtless, quite new. . . . The Royal Institution people have now had an opportunity of seeing that Spottiswoode's brilliant experiments can still be presented to them with additions, and I hope they will profit by the experience."

The next Discourse given there by Thompson was entirely upon the great researches of another man, Dr. Koenig of Paris, of whose work on Sound very little was known in England. It was given in 1890, and was entitled, "The Physical Foundation of Music."

Dr. Koenig sent for exhibition all the instruments and apparatus used for his researches. He lived in seclusion, surrounded by splendid apparatus, which had been seen and appreciated by Thompson during some of his brief visits to Paris. *The Musical World*, commenting on the lecture, wrote :

"One of the most important lectures given in England for some years on the Theory of Sound was delivered by Dr. Silvanus P. Thompson, on Dr. Koenig's theories and recent discoveries concerning musical sounds. Dr. Thompson spoke extemporaneously for over an hour, and said that Dr. Koenig's deductions had been drawn from physical experiments extending over twenty years."

This lecture led to considerable correspondence and criticism, and to one inquirer, Mr. R. H. Bosanquet, F.R.S., Thompson wrote :

"I will put your query to Dr. Koenig, and send you his reply. Please bear in mind that on Friday I spoke purely as the exponent of Koenig's views, not necessarily of my own : otherwise I should have said something in criticism of the whole method of wave-sirens, and should have suppressed sundry other things that Koenig wished to be said. I wish you had been in front of the wave-sirens, as they can not be heard from behind with any success."

In 1891 Thompson gave his first course of four afternoon lectures on "The Dynamo." This year also, at the age of forty, there came to him the honour of receiving the blue

ribbon of Science through his election to the Fellowship of the Royal Society.

For two or three years previously to this, people had been questioning why his work had not been already recognised by that body. When they spoke to him about it, he always said, "I am in no hurry. I bide my time." When the recognition did come, he was pleased and gratified, and so were many of his friends.

Professor Perry wrote :

"DEAR THOMPSON,

"Congratulations are usual in these cases, and therefore I send you them. But it is the R. S. that ought to be congratulated."

Sir William Crookes wrote :

"MY DEAR SILVANUS, F.R.S.,

"Ten thousand congratulations !

"From very sincerely yours,

"WILLIAM CROOKES."

From Mr. J. Fletcher Moulton (afterwards Lord Moulton) :

"Let me congratulate you very heartily on your F.R.S. I cannot understand why it has been delayed so long.

"Yours ever sincerely,

"J. FLETCHER MOULTON."

From the Council of the Junior Engineering Society :

"Hearing with the greatest gratification of the distinction which has recently been conferred by the Royal Society on Dr. S. P. Thompson, the Council beg to offer to him, their President, the expression of their cordial congratulations on his election to its Fellowship, which they fully recognise as constituting the due acknowledgment of the important services which he has by continued research rendered to the progress of science."

Of Thompson's work for the Royal Society more will be told later on. The Hon. Secretary, Mr. Arthur Schuster, wrote in 1916 expressing admiration of his scientific re-

searches, and added the opinion, "His successful work has never been sufficiently recognised by the Royal Society."

This year (1891) was perhaps the busiest in Thompson's busy life. After college courses were finished for the session, he had two important lectures to prepare before he could get away for his holiday, the Lecture to Working Men at Cardiff during the meeting of the British Association there, and an address to be given at Frankfort, where he had been appointed Vice-President of the Electrical Exhibition, and where an International Electrical Congress was to be held. The following extracts from letters to his wife written in July, when she had taken the children to visit her sister in Aberdeenshire, show some of his interests at that time :

" July 14th.

"The lonely grass-widower finds his house strangely quiet and empty. I am living a desperately quiet life here : and yesterday it seemed quieter and duller than ever.

"Herkomer writes me that he is much overworked, and is going from Bushey this week. He will paint the portrait in the autumn, at Bushey. The Italian Edition of my little *Electricity* is out. I got a copy to-day.

"To-morrow evening I am going to Mr. Wimshurst to arrange with him about republishing—with cuts that he will give me respecting his machines—my paper on *Influence Machines*, for which there is a demand.

"Tell the little girls that papa watered their gardens for them this evening ; and that he has taken down the swing. I am getting a lot of writing done."

" July 15th.

"Never a line yet from you to say how you fare : and how the little birdies stood the journey ! All is going on steadily and quietly, and I am very busy.

"More proofs ; manuscript of my Cardiff lecture progressing, and a paper ready for the Frankfort Congress growing into shape.

"I had a pleasant couple of hours last evening with Mr. Wimshurst amongst the machines. I want him to work out a very simple sort of machine that every schoolboy might be able to make and use. It is lovely weather—too hot indeed."

" July 23rd.

"Time wears on, and I shall soon have to pack up my traps, whether my work is done or not. I have got through the bulk of all the work that necessitated actual residence among my books : but there is a good deal of actual writing yet to do, not to mention scissors-and-paste work. Some of this I must bring with me, I fear. I shall not be able to leave before the 29th.

"Yesterday was a busy day. I worked hard at home till nearly 12. Then went to College, kept three appointments, then went to New Cross. After that I returned west by train to Earl's Court to see the dynamos at the German Exhibition—a poor show it is—and then, snatching a hasty dinner at the Exhibition, I went to a Committee Meeting at London University—and so home to bed. Nell's letter came with yours while I was out. Many thanks to her and you.

"The auratum lilies are out ; I have one in the study, perfuming it amazingly."

" July 25th.

"The law court case comes up on Tuesday, and will be disposed of that day. I shall therefore, if all is well, go to Settle next day, and am writing Marie accordingly.

"I shall not have finished all my literary work : but have got on tremendously the last week. The garden is splendid, roses magnificent. I had a feast of three ripe strawberries last evening ! [from Dorothea's little garden]. Love and kisses to my pets, one and all."

The garden at Hampstead and the little greenhouse were always a joy to Thompson, and he managed to spend many odd minutes and hours among his beloved flowers and plants. He was very fond of fuchsias and possessed many varieties, crossing them himself, and producing new seedlings. One summer he had fifty-two different varieties in flower. He used to send cuttings to his friends. Twenty years later, when Hampstead had become more urban, the results in the garden were rather discouraging to the enthusiastic gardener.

About two years previously to the date of these letters, Thompson had become acquainted with Hubert Herkomer, R.A. (afterwards Sir Hubert von Herkomer), and

found him an attractive personality. Of Bavarian ancestry—his father was a wood-carver who had emigrated to the United States—Herkomer had a good many of the ways of an American. He was then living in two small cottages down at Bushey, where there was a large Art School, to which he freely gave his services as teacher for many years. He seems to have been attracted by Thompson also, and often pressed him to go down to Bushey. His enthusiasm as a teacher, and his anxiety to enlarge the horizon of his students, enlisted Thompson's sympathy, and he helped him by lecturing to them on "Colour and Pigments" from the scientific point of view. He was also interested in the new house, a veritable palace of Art, which Herkomer was building for himself at Bushey. He advised Herkomer over its lighting by electricity, and recommended to him young men who would be willing and able to carry out his ideas. Herkomer in return painted a very fine portrait of Thompson, which he presented to him. It was in process of being painted for several years, both men being so busy that it was difficult to fit in the necessary sittings. Many visits to Bushey were paid by Thompson and his wife, on Saturday or even on Sunday afternoons. For the sake of making a pilgrimage down to that simple yet artistic home, he would occasionally break through his almost invariable rule of keeping Sunday as a "home" day.

Previously another of his artist friends, Mr. J. Walter West, who had a studio in Hampstead, had also painted a large portrait of him in his robes as Doctor of Science of London University. Unfortunately, from 1889 to 1892 Thompson wore a beard, in which he is represented in this picture, but which he had given up wearing before Herkomer's portrait was begun.

In the spring of 1894 Thompson again gave a brilliant Friday Evening Discourse at the Royal Institution on "Transformations of Electric Currents," remarkable for its ingenious experiments. That year the British Association was held at Oxford, and his friend Professor Oliver Lodge gave his paper which foreshadowed wireless telegraphy, and succeeded in sending messages from one building to

another. Mrs. Thompson also attended the meeting, and they stayed in some students' small rooms in Ship Street. The week spent among the architectural grandeurs of old Oxford was a great joy to them both. Thompson was tired that summer, and read no papers at the meeting. After it was over they went off to Switzerland, accompanied by his sister Rachel and the two eldest children. They spent a long time at Riffel Alp, which he found an excellent centre for sketching. They drove homewards over the Furka Pass through a deep fall of early snow.

In 1895 Thompson's brother-in-law, Ellwood Brockbank, came with his family to reside near London at Winchmore Hill; the only unmarried sister, Rachel, also left Settle at the same time, and came to live with them. It was an added joy for him to be able now to see his sisters more frequently, and Saturday afternoons were sometimes spent together. In July of that year Mrs. Thompson went to Buxton with her mother, and the following extracts are from letters to her :

" July 14th.

" There were many inquiries for you on Friday night at the Swans—where all the world (the scientific world) and his wife (especially his wife) were present. I felt curiously lame and out of place to be there alone. They had some music and singing and Hilda recited. Rachel did not go, she was suffering from facial neuralgia.

" On Saturday, after my Committee meetings were over, I went to Winchmore Hill, arriving there before four o'clock. I like the house ; it seems, but for the distance from the station, a very desirable spot.

" Marie was looking very well. Irene was blooming, and said she did not want to come home. Marie seems very glad to have her. We had tea in the garden, and the children had a high old time making a 'Bedouin tent, and defending it against the armed robbers !

" On Monday I shall have a very busy day with meetings of the College Committee, and at the University ; and in the evening dinner at Miss Jones'. The statistics of the Annual Report that I have sent in show that, of 421 day students who have gained the certificate since I became Principal, no fewer than 393 have stuck to the professions

for which the College prepared them. This is a very surprising result."

"July 18th.

"I have just come in from the conversazione at Toynbee Hall—an interesting gathering. . . . No further news, except that Mr. Chas. Brown of Baden is coming to see me to-morrow at Finsbury. In the evening is the concert at the School."

"July 21st.

"Saturday was Dorothea's birthday: and what with her watch and chain, her new dolly, her letter from her mamma, her innumerable small presents from sisters and cousins and aunts, she had enough to think about. Yesterday Mr. Brown of Baden came to lunch and stayed with me the whole afternoon, much to my delight. I got no end of useful tips in completing the revision of *Dynamo*. He carried off with him a copy of the *Polyphase* book, which is now out."

"July 22nd.

"I am now getting rapidly toward the end of the revision of *Dynamo*, but it takes a vast lot of work. Walker is an admirable helper in all this. I have had another busy day of College and University business, but this evening have been drawing for the *Dynamo* book. But there was no one by to read to me!"

"July 24th.

"Walker and I are working like Trojans to get the rest of the MS. of *Dynamo* licked into shape within the next ten days. It is no easy business: and there is a terrible lot of it. However, three-quarters of the book is revised, and more than half is in the printers' hands. So the last quarter won't take so long.

"I went to Wilfred Ball's bachelor 'At Home' last night. There was some good music, many artists; and a lot of pretty things in his studio."

Thompson's great admiration for the work of Faraday led him, during the years when he was lecturing at the Royal Institution himself, to make constant use of the records and notes of his work, which are among the treasures of the Institution. He studied the apparatus made by him, and would often show pieces of it when lecturing. His frequent references in public to the work of this great

genius showed his enthusiasm for the man. Faraday's friendship for his great-uncles the Phillips, and hearing of him from his cousin, Lady Wilson, daughter of Richard Phillips, added a personal link to the already attractive character. The following letter to Sir William Crookes, then Hon. Secretary of the Royal Institution, is of interest :

“ DEAR SIR WILLIAM,

“ During some recent lectures to my classes, I have been going over Faraday's fundamental work as narrated in the first and second series of his *Experimental Researches* in the discovery of magneto-electric actions. In the course of this a suggestion occurred to me that I think worthy of putting before you. It is this, that it might be of interest if one were to try in a short series—say three—of afternoon lectures at the R. I. to reconstruct, as it were, that celebrated research, and show the experiments *as nearly as possible as Faraday showed them*; making all the experiments as he made them; and wherever possible with his own apparatus. One has seen—and shown—the experiments so often with modern appliances that to many it is difficult to realise the conditions under which Faraday was working. How does this suggestion strike you? There is another thing I have been thinking over. These researches of 1831 are so absolutely vital in the history of Science that every detail in their making is of intense interest. Now, though the account in the *Experimental Researches* is partly narrative and fairly detailed, it is not in the same order as the experiments as recorded in Faraday's own laboratory notes. I think that Faraday's own notes as they stand would be valuable to the world. Do you think that the R. I. would allow me to transcribe and print them as a small book? ”

The first of these suggestions was welcomed by the Managers of the Royal Institution, and the lectures were given, but the second was never carried out.

In 1894 Sir Henry Roscoe was editing a series of short biographies of scientific men of the nineteenth century, and he immediately thought of Thompson, and wrote to him as follows :

“ The series is to be written in a scientific spirit, but made readable. Thorpe is doing Davy, Percy Frankland,

Pasteur, etc. I write to ask whether you will write *Faraday and his Work* ? It is a tempting subject, and I feel sure that you would do it justice. Each volume is to be about 200 pages of small pica type, and will therefore not be lengthy. Indeed, the difficulty will be that of compression.

"Cassell's pay the authors each £80. I can send you a dummy volume if you wish to see the size of the proposed series."

Thompson did feel much tempted to write about a man whose character he so greatly admired, and whose work had been such an inspiration to him, so in spite of his many engagements, he undertook to add one more task to those he had before him. Three admirable biographies were already in existence, but were all expensive books, and were all out of print ; so, as Thompson wrote in his preface to his volume :

"There seems room for another account of the life and labours of the man whose influence upon the century in which he lived was so great. For forty years he was a living and inspiring voice in the Royal Institution, beyond all question the greatest scientific expositor of his time. Throughout almost the whole of that time his original researches in physics, and chiefly in electricity, were extending the boundaries of knowledge and laying the foundations, not only for the great developments of electrical engineering of the last twenty years, but for those still greater developments in the theories of electricity, magnetism, and light, which are every year being extended and made fruitful."

Thompson was allowed to print extracts from some of Faraday's original notes, and also obtained access to some of his private letters and papers, which were in the possession of the Barnard family, nephew and nieces of Faraday. He was a very long time in getting the book completed, for as usual he took infinite pains with the details of the biography, and that entailed research and correspondence with the few old friends of Faraday who still survived. Sir William Crookes lent him some excellent portraits, and also gave him others. Thompson was not quite satisfied with any portrait or photograph of his hero, for to him Faraday was a hero ;

so after long comparison and study of all available likenesses, he drew one for himself, etched it on copper, and it was used as the frontispiece of the book which appeared in the autumn of 1898, after many reproaches from editor and publisher for its long delay. On October 17th, 1898, he received the following letter from Sir Henry Roscoe :

“ MY DEAR SILVANUS,

“ I forgive you all your iniquities ! for I have just read every word of your *Faraday*, which is *excellent*.

“ It will form a good finish to the series, and I am much obliged to you. I hope that the portrait has come out well.”

From his friend Mr. Conrad Cooke :

“ Accept my warmest thanks for your most delightful gift, which I value greatly for several special reasons. First as a very welcome present, another proof of your kindly feeling towards me, next as one more example of your wonderful industry and research, coupled with both literary and artistic talent, for the portrait by you (evidently painted in oils) is an artistic rendering and a most excellent portrait of the dear great man as I so well remember him ; and lastly, and I cannot say the least, your book is a treatment of the life of my very dear old friend, whom I loved with all the freshness and reverence of a boy's heart, such as has not been done before. Tyndall's book should have had the title *Faraday's life of Tyndall*, and neither Bence Jones nor Dr. Gladstone have come more than on the border of the field you cover. Oh, how you would have appreciated the beauty of mind, the loveliness of that dear, good man, and his exquisite manners ! ”

Professor David Hughes wrote :

“ I have never seen so complete and interesting an account of our great Master that all electricians worship. It is the matter of the greatest surprise to me that you are enabled to find time to write such a work, knowing as I do that every moment of your time is so fully occupied. I am full of admiration of your talent and energy.”

Thompson had prefixed to his volume some verses on “ A Portrait of Faraday,” by Mr. Cosmo Monkhouse, whom

he knew, and whose poems he much admired. Mr. Monkhouse wrote to him :

“ I was pleased at the honour you did my verses. It is no little pleasure for a poet to find that what he has done more than five and twenty years ago still ‘ lives ’ in the estimation of men like you.”

Sir Joseph Swan, who had known Faraday, wrote :

“ Faraday is to me the ideal of a great and good man ; truly he was in his simplicity sublime. It will always be one of my most precious memories to have conversed with him in his home. You have done a good work most admirably in giving to the world this further account of the life of Faraday.”

Lady Wilson, a cousin of Thompson, wrote :

“ I shall read the book with great interest, though I fear not much understanding of the scientific parts. I so well recollect Dr. Faraday and being nursed by him ; he was always so devoted to children.”

Afterwards Lady Wilson gave to Thompson all the letters which had been written to her father, Richard Phillips, by Faraday. They were greatly treasured by Thompson among the collection of autographs which had come to him from his father and grandfather. Thompson received also many appreciatory letters from his foreign friends, M. Mascart of Paris writing : “ Vous avez fait un acte de véritable piété scientifique en publiant ce beau livre du Faraday.” Dr. Koenig also sent a long letter of appreciation.

The author was at once approached by a German publisher for permission to publish a translation. Thompson gave his consent ; the author of the translation, Herr Dr. H. Danneel, made an admirable translation by the help of his wife, an Englishwoman. On its completion they wrote to Thompson saying how much they had enjoyed translating the Life of this most noble and good man, and that throughout their work they had felt that the writer of the book they were translating was himself a man of a noble spirit.

From Mr. Elihu Thompson, of Massachusetts, he had also appreciatory criticism :

“ Since I first read Faraday’s researches I have been a warm admirer of his genius. You have succeeded in bringing the man himself before us, and have given us a better insight into his character and life than we have hitherto been able to obtain. I am glad that you have testified in such a way to Faraday’s worth, for we all know that you are, a master in book-making. Our young men must certainly receive inspiration from the work.”

Sir William Crookes sent to Thompson a fine old engraved portrait of Faraday, with the accompanying note :

“ MY DEAR SILVANUS,

“ Because I have so high an admiration for Faraday, I gladly give the enclosed picture to you, who have given to the world the best literary portrait of him as a man and a philosopher.”

Some years later Sir William again presented a portrait of Faraday, a very fine daguerreotype, to Thompson, who thus expressed his thanks :

“ DEAR SIR WILLIAM,

“ Daylight only adds to the beauty of the Brande-Faraday daguerreotype which you so kindly and unexpectedly presented to me last night. I fear my thanks seemed feeble : but you fairly took my breath away. I presume the date was somewhere about 1848, or in any case anterior to 1850.

“ Yours most gratefully,

“ SILVANUS P. THOMPSON.”

In 1891 Thompson was invited to lecture at Berlin in the Urania Theatre, an institution similar in some respects to our Royal Institution. His subject was, “ Faraday and the English School of Electricians,” and the lecture was given in German before a large and enthusiastic audience. He had to go to Berlin early in January, and, as the lecture was illustrated with experiments, had to spend a few days there in preparation for it. The cold was intense. He wrote to his wife :

"It is a new experience to find one's breath forming icicles that hang down from one's moustache. But one *feels* the cold far less than one feels the chilly damp cold in England. I have been busy all day, in a horribly overheated laboratory, getting my experiments ready. There is very little more to do, so I am well up to time."

On January 9th, the day of the lecture, he wrote :

"It is now five o'clock, and I have just returned from an hour's quick walk in the Thiergarten.

"All my preparations were complete and every experiment rehearsed before half-past one. My lecture is at eight o'clock. All the experiments go well, particularly the kinematograph diagrams that I took so much pains to draw. After the lecture I am to go to supper with Professor Neesen."

"January 10th.

"All went off well last night. The papers will probably say that I lectured for two hours, as it was 10 o'clock when I finished. But they begin at ten minutes past eight, and they give a pause of ten minutes in the middle, so that the audience can go out into the foyer to drink a glass of beer ! How thoroughly German !

"Happily all the experiments behaved themselves well : and the kinematographic demonstrations were a perfect success. There were a number of familiar faces—the Kapp family, Von Hefner, Alteneck, etc., etc. My voice held out well, I found it quite easy to read, and not hard to speak the descriptive part about the experiments.

"Professor Neesen had a whole party to meet me. The ladies made a regular *schwärmerei* around me. It was quite comic. Of men there were Lummer, Rubens, Pringsheim, Thiesen, Biedermann, Spiez, and Du Bois—Ach der schöne ! Professor Neesen proposed a toast in my honour about midnight. I replied bilingually and briefly."

"January 11th.

"I had a very pleasant time yesterday—visiting the Reichsanstalt, and spending the time mainly with Lummer and Pringsheim. I walked back to Berlin, had a nap and some tea, and then went back by train to Charlottenburg to dinner with the Kohlrausch family. Professor Kohlrausch desired to be remembered to you and Sylvia. We

had a party of about ten, all 'physikers' except one, his son. I think about half the time they were discussing with me points raised by my lecture. I have seen three reports in German papers. One says that Professor Thompson, who is only of medium height, does not look at all like an Englishman. But it does not say at all what he is like ! I gather that the term of highest praise about any descriptive lecture is that it is *plastisch*. That adjective is at least once awarded me. This evening I dine with the Kapps.

"I came across an old Finsbury student here. He is making contracts for train-lighting with the German railway folk. He speaks with admiration (mingled with some envy) of the intelligent business capacity of the people here, all alive and enterprising."

To leave the subject of Thompson's life in London without reference to his connection with the University of London would be to misrepresent his civic spirit, for in his opinion no city was complete without its university.

It is impossible to give an adequate idea of the amount of work he did, during some twenty years, without devoting a whole chapter to the history of the movements and the traditions, personal and impersonal, which, working at cross purposes, so protracted the reform of the University.

When Thompson moved to London early in 1885 he found the leading graduates amongst the members of Convocation (the "lower" House for the government of the University), intent upon the adoption of some scheme comparable to one which had just been projected by an association for the Promotion of a Teaching University for London. He at once associated himself with the movement, then reaching a critical stage, and before he had been six months in London he ventured to criticise the proposed scheme of reform in a letter to *The Times* the day before the decisive vote was to be taken in Convocation. He was most anxious that the University should cease to be chiefly and almost solely an examining body, content to accept candidates with no college record, and that it should become an association of teaching bodies ; but he thought the scheme suggested would fail in that purpose, and that it was more-

over retrogressive in augmenting the powers of the Crown-nominated Senate at the expense of the graduate body, Convocation. At the meeting of Convocation Thompson spoke against the policy, which was eventually rejected. A day or two later he received the following in a letter from one of the members of the disappointed group of leaders :

“ The issue of Tuesday’s discussion did not altogether surprise me, but what did surprise and puzzle and perhaps to some extent annoy several of us, was that no definite views were expressed as to what ought to be done, but the position and tone was (speaking generally) mere opposition to doing anything. In your speech, however, I thought we were probably meeting a friend in the guise of an antagonist, and that, although you objected strongly to some points in the scheme, you were disposed to accept some of its main provisions. My object in writing is to ask whether this opinion of mine is a right one, or whether your opposition to the movement is radical and unalterable. In the former case I cannot but think that we might profitably exchange ideas on the subject, and you would perhaps find that we had more in common in our views than you expect.”

Another group of reformers, including this writer and Thompson, set to work to draft a different scheme, which, though accepted by Convocation, was rejected by the Senate, which in turn projected a scheme unacceptable to the lower House. These differences of opinion and protracted debates extended over some years. Meanwhile the University Colleges and the Colleges of Surgeons and Physicians were petitioning the Queen for power to grant their own degrees as separate institutions, leaving the examining body undisturbed in its old course. Thompson was foremost in opposition to such schemes, and wrote letters to *The Times*, pointing out how disastrous they would be to the prestige of the University. Parliament refused to grant the petitions, and, to escape the deadlock, a Royal Commission was appointed. When the reports of this body were presented in 1889 to the Senate, Thompson was one of the nine members of Convocation elected to be present at the deliberations of the upper House, and was frequently in attendance. The minority report of the Commission favoured the estab-

lishment of a second, a teaching University of London, and for many years a strong party supported that course, and long and hot was the battle that ensued, Thompson leading in the arguments in favour of reform of the existing body. Looking back some years later, he drafted the following historical statement about the efforts of that period :

“ It will be remembered that after the failure in 1892 of the Senate and Convocation to agree upon a scheme of reconstitution by way of a new Charter, application was made to the Privy Council by persons representing chiefly University College and King’s College, for a separate Charter for a Teaching University in London, the distinctive feature of which was that it was to be exclusively metropolitan and collegiate, as it entirely excluded non-collegiate students. To this proposed University so restricted, the name first assigned was that of the ‘ Albert ’ University ; but, while the petition for its creation was still under the consideration of the Privy Council, the name of ‘ Gresham University ’ was substituted, with the concurrence of the Trustees of Gresham College, who had in the meantime agreed to assist the proposed teaching University. .

“ Owing to the great opposition which arose not only on the part of both Senate and Convocation, but also on the part of many influential persons interested in education all over the country, Parliament refused its sanction to the granting of the charter to the proposed Gresham University, and the scheme for establishing a second university in London fell through.

“ Had a separate Teaching University been thus established, it would have been a crushing disaster to the University of London, since it would soon have absorbed all the intellectual life and the material resources of higher education in London. Its establishment would leave the present University doomed to be for ever a mere Government Board of Examinations, like the Civil Service Commission, under whose control it would probably have drifted.”

At one time, when the party feeling was very acute, and personalities were not kept in check by the hotheads, Thompson drafted “ A letter to a Graduate ” with the following personal introduction :

“ You tell me you have heard it said that my efforts to help forward this great educational movement are dictated by the circumstances that the Finsbury Technical College—of which I have the honour to be Principal—is to be one of the constituent colleges; and that I want to get easy degrees for my students. Pray tell any of your friends, who have been told this, what the facts are. No one has ever proposed that the Technical College should become a constituent college. If any one were to propose it, I, as its educational head, should oppose the suggestion to the uttermost. The Technical College is a technical, not an academic, institution. Its students do not work for any degrees or outside examinations; the training it gives is professional rather than scholastic. To make it a University College would be entirely to change the character of its training, and divert it from its present useful though less ambitious work. I have thrown my energies into the present struggle, because I want to see my own University grow great, and exercise all the functions and powers of a great University; and I strive the more earnestly, because of the extraordinary courses which have been taken to cloud the issue, and to raise prejudices and misconceptions concerning the great scheme of reconstruction which is now so near being realised.”

When it was found that agreement could not be reached within the University a second Royal Commission was appointed, and reported after many months. The report was at once seized upon by the various parties, but the details of the struggle cannot be entered upon here. It continued for two years before both those who supported and those who opposed the scheme of the Royal Commission and the proposed Bill to put it in force appointed separate deputations to wait upon the Prime Minister, Lord Rosebery. Huxley led the supporters, and of those who spoke Thompson held out most hope of reconciliation. Rosebery's Government fell before he accomplished anything in the matter; and the battle had to be fought out again with the Duke of Devonshire when Lord Salisbury's party took office. The London newspapers at that time paid no little attention to the university question, *The Times* published several long articles, and leaders devoted to the

progress of affairs, in which Thompson's position among the reformers is clearly recognised.

Early in January 1896 Thompson wrote to his wife :

"I am very busy writing a paper for the Society of Arts on the London University question. It was to have come off in February : but, with the questions coming on in Convocation, I got Wood to put it earlier, and had to take Jan. 15 — at rather short notice. Lord Reay will take the chair."

Two days later :

"London University affairs still keep me very busy ; the other side have put out a manifesto in *The Times* of to-day. I probably shall not go to meeting to-morrow [Sunday] ; but take a walk with Sylvia."

Three days later :

"I am very well and hearty. Fagged ? Not a bit. I am in splendid fettle. My Society of Arts paper was finished yesterday, and I am quite at ease. The University question continues quite at fever heat, with letters in *The Times* every day. There has been a run on the Society of Arts for tickets for my paper to-morrow night. I think the facts will open the eyes of a few people."

The facts consisted of sheets of statistics about Universities all over the world, with pertinent comments upon comparative expenditure and revenues, professoriates and students, libraries, laboratories, etc. The following extract may perhaps be considered the definition of his title, "The Making of a Great University."

"It is, therefore, from the point of view of the scholar, whether he be nominally student or nominally teacher, that the claims of a university to be considered great must be decided. Does it bring him into an atmosphere of mental activity and progress ? Does it afford contact with living thought ? Does it give the stimulus of intellectual struggle so essential for improvement of knowledge ? Does it furnish the means and appliances of learning ? Does it provide the scholar with libraries, and give him access to

the mental furniture of the past and of the present ? Does it offer to the investigator the means of pursuing research ? If it does, then it is fulfilling its functions as a university. The test of greatness is to be found in the degree to which it thus ministers to the intellectual progress of the age."

Two years later it appeared that the battle was won.

On August 1st, 1898, Sir Thistleton Dyer wrote :

" MY DEAR SILVANUS THOMPSON,

" Though somewhat late in the day, I must write a few words of congratulation on the London University Bill passing the House of Commons.

" What I feel is that, though many of us have worked pretty hard at times in this business, it is to your indefatigable energy and enthusiasm that we owe having educated opinion in Convocation.

" When the Bill has received the Royal Assent, don't you think we might celebrate the event by a modest little dinner ? "

When about ten years later, in 1907, and when no longer a member of the Senate of the University, Thompson wrote to Oliver Lodge his recollections of the struggles of those earlier days :

" You ask about the *Graduates' Union*. It is a body which was started ten years ago, or so, amongst the active members of Convocation, to promote the *reconstruction*, at the time when our then M.P., Lord Avebury, was hesitating whether to support or oppose reform, and before the Bill had been introduced. It was followed by the creation of an opposition body, the *Graduates' Association*, under Collins, Napier, etc., to oppose the reconstruction. This latter body has always shown a sort of vindictive hatred of " teachers," and has opposed the election of any teacher on the Senate. It got the ear of the provincial graduates, and of the protégés of the " Correspondence College." And it was this body which at a Senatorial Election put in a nobody named — (M.D) in opposition to Lord Lister. It has absolute control over the graduates in the Arts Faculty, owing to the immense preponderance of illiterate B.A.'s who have come in through the cram-shop ; and it further has much weight in the Laws Faculty, which is very small. Its shining lights are

[Lord] Moulton and [Sir Wm.] Collins. It tries to run all university matters by caucus; selects the names of the graduates to be run to represent Convocation in senatorial elections; and sends a very third-rate class of men (except Moulton). Not only does it thus govern (save in Science Faculty) the election of the convocation members of the Senate, but it even directs these members how to vote in the Senate. This degradation of university politics and their persistent attitude of opposition to the internal side of the University, by the graduates of the 'Association,' has become unendurable. The graduates' 'Union,' on the other hand, when the reconstruction took place, kept quiet. It wished things to have a fair trial. It never attempted to run candidates to represent the internal side; it wished both sides to have a fair chance. . . .

"I detest all party lines, whether in public politics or university matters. I refused to be nominated for the Senate eighteen months ago by either party as a party. I should do so again if I were asked to stand on such a basis. But apparently those who feel the pinch of the obstruction more than I do agree that the battle must be organised more on party lines. That is the meaning of the present circular."

In October 1900 Thompson was elected by Convocation to the Senate of the University. He had been invited by the secretary of the science committee of the "Union" to be one of their six nominees, the others being Sir Michael Foster, Prof. Carey Foster, Prof. Vines, Sir Henry Roscoe, and Mrs. Bryant. He was told, "We can't guarantee election, as Moulton's crowd also has a list, but a less eligible list than our 5, and it was impossible to compromise with them."

Outside the University also he was much occupied. Earlier that same year he became a member of the Council of the London Society for the Extension of University Teaching, of which Lord Avebury was President. The secretary, Dr. Kimmins, wrote to him, "Your presence on the Council just now will be of immense value, as we are coming into close connection with the new Teaching University."

The following year Professor Ramsay wrote asking him to join in a movement to investigate the work of the London

Polytechnics and stimulate the real work, which might be regarded as bearing on industries, and to discourage competition with University Colleges.

The Senate was busy with details of the reorganisation of the University. The registrar had gone, the Principal Officer had not yet been appointed in May 1901 when Thompson wrote the following letter :

“ DEAR VICE-CHANCELLOR :

“ In view of the few words which you dropped at our chance meeting to-day, I think I ought frankly to let you know that if it were to be understood that the University is in fact contemplating the step of appointing a Principal Officer, and if that post is to be distinctly an academic one, I should inform my friends that, in the event of the post being offered to me, I should take it. I know it cannot be a heavily salaried post. If I were chosen for it, I should resign, not only my Professorship here, and the Principalship of the College, but also sundry examinerships, and the whole of my professorial consulting work. But whoever undertakes the duty must have no other outside interests or calls upon his professional time. I am not yet fifty. I have my limitations and my failings—the consciousness of them is only too well known to me. But you know them too, and have at any rate the advantage of knowing whether those limitations and defects put me out of the running.

I shall be to-morrow at Committee Room 15 (Derby and Notts. Electric Power Bill) at the House of Commons. If you are going to Committee Room 8 I should like to meet you.”

The appointment was a government one ; and Thompson was not a *persona grata* at that time, possibly on account of his opinions on the Boer War.

One Monday in November 1900, several London newspapers contained a paragraph somewhat similar to the following extract from *The Times*, presumably communicated by a visitor at the ordinary morning meeting in the Meeting House in St. Martin's Lane.

“ Speaking at the Westminster Friends' meeting yesterday morning, Professor Silvanus Thompson said this country had reached a period in its national life when, reluctant as many people were to pass judgment on others,

yet, if they would live up to the Christianity they professed, it was incumbent upon them to do so. He and others had waited patiently and prayerfully for fifteen months for the tide of passion excited by the war in South Africa to recede. But, after a lapse of fifteen months, the country was face to face with horrors of the most appalling kind. Take one simple fact. A country which was flourishing fifteen months ago was now in a state of devastation, its farms in ruins, its women and children turned out on the veldt, enclosed in camps, and surrounded by soldiers with the bayonet in their hands. Yet from the official Christianity of this country—he would say nothing of the unofficial Christianity—no voice was raised in protest. He did not know of any Bishop, or of any archdeacon, or of any dean in the Church of England who had said one word against the inhumanities which were being perpetrated. It was no answer to say that the Boers declared war. Admit that in form they did, yet he remembered well the days and weeks preceding the outbreak of war when things were said and acts performed showing too surely that this country was drifting into war. And for the first time he felt it a degradation to be an Englishman; the responsibility for it all must go to somebody's account. In keeping silence he and others might be regarded as accomplices. That was why, loth as he was to pass a judgment on others, he felt compelled to raise his voice against this example of 'man's inhumanity to man.' "

A good many of Thompson's friends fully expected his appointment to the position, but, though his name was among four finally considered, the choice fell upon another, Professor Arthur Rücker, M.P.

Thompson took an active interest in the Library of the University, and served upon its committee. He was out of sympathy with the growing imperialism of the day, which reflected itself in the deliberations of the Senate, with whose schemes he found himself frequently in disagreement, and in a small minority. He was not re-elected when his term of office came to an end. The same spirit prevailed and reflected itself in the proposal a few years later to found at South Kensington, side by side with the University, a Technical College of Applied Science for the whole Empire, a "New Charlottenburg." To quote *The Times* of July 1905:

"It cannot be doubted that the Imperial aspect of the scheme and the provision in the metropolis of an Imperial College of Applied Science in which will be found unrivalled resources for study, instruction, and research must be of the greatest assistance in the industrial competition with other countries, which continuously increases in severity and demands the utilisation of all possible aids to success if we are to maintain our position."

This scheme was the uppermost interest in 1907 when Thompson was again nominated to represent the science graduates in Convocation on the Senate of the University. Sir W. T. Thistleton Dyer wrote :

"I must congratulate you on your election into the Athenæum.

"I duly signed and dispatched your nomination paper [London University]. Judging from what you say in your address, the people who are now manipulating the University must be insane.

"I entirely agree with you, and hope sincerely that you will be successful and able to put on the drag.

"I always had grave doubts about the new constitution. Now that Universities are scattered all over the country I very much doubt whether an external side is really desirable at all. Anyhow, it should not be allowed 'to call the tune.'"

Thompson was not elected. He was in Paris with the party representative of London University which went over on a visit to the University of Paris in May 1907, and wrote to his friend T. Bailey Saunders a letter showing how disappointed he was in his University on that occasion ; he felt, on perceiving the excellence of the French manner of receiving them, how sadly London lacked academic distinction :

"It is a gorgeous farce, the Vice-Recteur is devoting himself to us nobly. . . . He sent a note to Rücker that they wanted the distinguished members of the *academic* side of the Faculties of the University—to meet their colleagues in Paris. One of the Frenchmen asked me to-day how it was that the University had sent so many distinguished men of science, and so few men of distinction on the literary side ! What *could* I reply ? . . .

" You can easily imagine how much amusement I derive from the events of the visit. It is quite impossible to make my friends understand how it is that my chair is not a chair in the University, or that my only reason for being of the party is that I was once ' on the Senate ' of the University.

" By the way, you saw the result of the senatorial elections. The caucus carried every seat except Sir Thomas Barlow's. Mrs. Bryant was chucked out ; I was a long way below her, and Dr. A——, F.R.S., bottom of the ' list. . . . There was an absolute campaign of lies. It is beyond measure pitiable to see things drifting."

His amusement was distinctly bitter.

Another time he wrote of the way things were going :

" Our good friend Rücker scouts the danger. He is developing a full-blown bureaucracy, with an army of clerks at his back. There are troubles ahead."

When the university policy drifted into " recognising " teachers in Institutions outside its borders, Thompson was in 1913 given the title of Professor of Applied Physics in the University of London. In this capacity he delivered a course of three " University Lectures in Physics " at University College in the winter of 1914, on " Studies in Historic Magnetism."

After his rejection in 1907 he had very little indeed to do with the University, having lost heart with its state of perpetual " internal dissension," and " wheels within wheels," as described to him by Professor Meldola, an onlooker. For some years the Kelvin Biography absorbed all the time and energy to spare from his college and professional engagements ; but his interest remained alive. A letter came to him in April 1916 from Dr. William Garnett, as chairman of an Education Reform Council of the Teachers' Guild, for the improvement of Education after the war, inviting him to undertake the chairmanship of the sub-committee dealing with University and Higher Technical work in relation to Industry and Commerce.

To those who knew him in this field it seems that to the end Thompson counted as an educational reformer.

CHAPTER IX

RESEARCHES ON LIGHT AND RADIATION

THE presidential address of Sir William Crookes to the Institution of Electrical Engineers in 1891 entitled, "Electricity in Transitu from Plenum to Vacuum," gave great impetus to all those physicists who were engaged at that time in research work on the problems of the relationship of Electricity and Light both in this country and abroad.

For more than twenty years this great chemist had been engaged in researches on radiant matter. He had, among various other inventions, devised a glass tube of special form, that, by means of an improved air-pump, it could be exhausted to such a high degree that, when an electric current was passed through it, it glowed with a pale apple-green light which possessed several properties up till that time unknown. In his address of 1891, which was illustrated by most novel experiments, Crookes gave freely to the world the results of many years' research. He showed how this mysterious light, emanating from the Kathode or negative pole in his tubes, travelled in straight lines, could cast shadows on the tube wall, and could excite brilliant fluorescence and phosphorescence in crystals and minerals on which it fell.

A ray was capable of heating an object when directed upon it. When placed under the influence of a magnet the ray could be deflected from its path. Crookes described how his tubes were made, and how they could be exhausted, and thus provided means by which these extraordinary phenomena might be studied by other younger men. By Crookes and the English physicists the phenomenon was regarded as an electrical one, by the German physicists

Wiedemann, Hertz, and others it was regarded as more akin to light.

For some years previously to this Thompson had been at work upon the relation between electricity and light, he had in 1890 made an arrangement to write a book on the subject. It was planned out, and some parts of chapters written, but was never finished.

Ever since 1876, when he visited Dr. Geissler at Bonn (p. 48) and acquired some of his remarkable vacuum-tubes, he had been experimenting upon, and studying the phenomena exhibited by them, and a chapter of his projected book was on "The Phenomena of Vacuum-tubes." The Crookes' tubes were a great advance on any former vacuum-tube, and Thompson now began to turn his attention to the subject of phosphorescence, and fluorescence, which may be grouped under the name of luminescence, that is, the property of shining with visible light without being heated.

Other workers in the same field in Germany were Wiedemann, Hertz, Lenard; Röntgen; in France, M. Perrin, Henri Becquerel; in Italy, Professors Roiti, Cardani, and Villari.

On November 8th, 1895, Professor Röntgen of Wurzburg, while experimenting with a Crookes' tube, on directing the Kathode-ray on to a piece of cardboard painted with a fluorescent material, discovered that a ray could pass through blackened cardboard, and could cast a shadow on the luminescent cardboard. At once he recognised that this was something new, and he called the light the X-ray. He soon found that the rays could penetrate wood, cloth, even flesh, but that metals or bone were practically opaque. By placing his hand in front of the tube the shadow of the bones was clearly seen on the phosphorescent screen. This last was the most important discovery.

Next, Röntgen found that they could produce photographic action.

In January 1896 this discovery was reported in the *Lancet*. The account of it appeared a few days later in the daily press, and caused a tremendous sensation.

Thompson, who had been working on the very lines on

which Röntgen had made his discovery, at once grasped the facts of the experiments, and on the same evening of the day on which the account of the discovery was given to the world, he succeeded in showing at his laboratory in Finsbury the action of the X-rays in penetrating substances and casting shadows of bones, and also took photographs. Writing to his friend Dr. Kennelly of Harvard, Thompson confesses how much he was impressed by the possibilities opened out for research by this new discovery :

“ There has been such a dearth of novelties in the electrical way as I never remember to have occurred before. All the (inventive) world seems to have gone off on two crazes—bicycles and the X-rays. With the latter I have myself been badly bitten ; and have been very hard at work upon these most perplexing and contradictory phenomena.”

During the month of February Thompson and his assistant, Mr. Miles Walker, were busily engaged in various experiments, using fluorescent substances in contact with the photographic film to hasten chemical action when stimulated by the X-rays. The materials tried were finely powdered fluor-spar, sulphide of zinc, fluoride of uranium, and sundry platino-cyanides. While at work Thompson came upon an unexpected effect. He found, on developing a photographic plate, that where uranium nitrate or uranium ammonium fluoride had been used, a distinct action had taken place *through* a sheet of aluminium which is impervious to X-rays. He immediately wrote to Sir George Stokes, then President of the Royal Society, on February 26th telling him of this discovery, and received the following reply :

“ CAMBRIDGE,
“ February 29th, 1896.

“ DEAR PROFESSOR THOMPSON,

“ Your discovery is extremely interesting ; you will, I presume, publish it without delay, especially as so many are now working at the X-rays. For my own part I am not at all disposed to believe that the Röntgen Rays are due to normal vibrations, the hypothesis to which Röntgen himself leans. I think it far more probable that they are transversal vibrations of excessive frequency. That being

the case, I think what you have discovered belongs to the same class of phenomena as Tyndall's calorescence. . . . I am in correspondence with Lord Kelvin about the Röntgen Rays, and I should like to refer to your discovery, but do not mean to do so till you have published your result. I should be glad, therefore, of a notice of the publication. Perhaps you may be writing to him yourself. Of course if you have done so I am free to say anything to him. He is very enthusiastic, and might let something slip out, without thinking about it. Yours very truly,

"G. G. STOKES."

On March 2nd Thompson received another letter from Sir George Stokes :

"I fear you have already been anticipated. See Becquerel, *Comptes Rendus* for February 24th, p. 420, and some papers in two or three meetings preceding that."

This showed that, almost simultaneously, Thompson working in London, and M. Henri Becquerel in France, both discovered a new kind of ray. They continued their experiments, and in May Thompson sent in an account of his results, and of his new discovery, which he named "Hyperphosphorescence." His paper was not read until June 6th, and in the meantime M. Becquerel published an account of his discovery without giving the new rays any name; his account appeared before Thompson's, and the new rays were named the "Becquerel Rays."

Not discouraged by this, Thompson went on working at researches on luminescence and on means of producing better X-rays effects from the Crookes' tubes. By using a concave piece of metal inside the tube as a radiating surface for the Kathode rays, he was able to focus them better. He got a firm in Paris to make some similar tubes, and this firm wrote requesting that they might obtain the right to sell them, saying, "Ces tubes donnent une puissance bien plus grande que ceux actuels de Röntgen. Nous les appellerons tubes focus du Professor S. Thompson."

Later in April he received the following letter from M. Pellat, then secretary of the Société Française de Physique, concerning these focus tubes :

“ Ils ont eu beaucoup de succès à la Société de Physique, et ont été beaucoup admirés de toutes les personnes à qui je les ai montrés. J’ai pu faire devant la Société une épreuve très bien venue avec un tube focus construit sur vos indications par M. Chaband.”

As was his frequent habit during the Easter vacation, Thompson went in 1891 to Paris to attend the Annual Meeting of the Société Française de Physique, on the Council of which he was an elected member. On this occasion he had agreed to show experiments and apparatus and give an account of his recent researches.

He wrote to his wife from Paris on April 3rd :

“ The passage across the Channel was most delightful, as we had bright sunshine nearly all the way. Yet the land journey was dull on both sides. I had no end of bother with the douane at Boulogne about my box of apparatus, as it was not registered through to Paris ; indeed, not being a trunk, but a wooden box with lid screwed down, the railway folk would not register it at all.”

“ April 4th.

“ I have had a busy day. First I went to the Société de Physique to see what were the arrangements ; then to the Gare du Nord to fetch my box. Then back to the Société de Physique. After lunch a call on M. Cornu, who was out, then on M. Potier, who was President of the Société at the time of the Exhibition (1889) and who enquired after you. For the past three years he has been paralysed on his left side. He evidently appreciated a visit, and is immensely interested in the Röntgen Rays. Then I called on M. Michelet, the publisher ; and, after watching a fire in the Rue de Rivoli, came home to dine. To-morrow I am going to spend an hour or so with Dr. Koenig, and perhaps shall get as far as the Bois in the afternoon.”

“ April 5th.

“ After morning breakfast I betook myself to M. Koenig, with whom I spent about an hour and a half. He looks aged and far from well.

“ Then I walked, via Notre-Dame and the statue of Henri Quatre, and the Quai Voltaire almost as far as the Eiffel Tower, to call on M. Mascart, whom I found at home. I did not stop long ; but my principal object was accom-

plished in leaving with him a manuscript which I wrote last night to be read at the Académie des Sciences on Tuesday.

"I discovered on Saturday that the French folk are desperately behind-hand in the matter of the Röntgen Rays ; so I set to work to write a little information. Unfortunately, I have not brought with me any of my results, nor any of the apparatus : and, owing to the holidays, it is impossible to get any over, as the College is locked up, and the Sergeant away on his holiday. The day has been fine, with an Italian sky, and a fresh breeze from the north, so I determined to spend the afternoon in a walk about the Buttes de Montmartre. The new enormous Basilica of the Sacred Heart, now nearly completed, stands on the highest point. From its terrace there is a magnificent panorama of the city—quite unequalled, I should suppose.

"I heard service for about ten minutes in an immense and perspiring crowd, and then made tracks for my hotel."

" April 6th.

"This morning I spent unpacking my apparatus at the Société de Physique ; after lunch returned here to write. At four o'clock in came M. Tommasi to talk electrical things with me, and he stayed till nearly six, and dinner is just over.

"A party of noisy Americans has turned up here, who make the reading-room unendurable. They express their astonishment that the Parisians don't know anything about *Trilby*. Apparently they have derived their knowledge of Paris exclusively from that source ; for them *Trilby* is Paris, and Paris, *Trilby* ! "

" April 7th.

"Of to-day there is little to chronicle, because there has been so much to do ! My paper on the X-rays was read by M. Mascart at the Académie this afternoon. Ramsay turned up there. He is on his way back from the Pyrenees, where he has been collecting samples of gases from well-waters in the search for helium. He came also to the Société de Physique to-night. My show of things went off well. I met Mascart, Joubert, Desroziers, Koenig, Palas, and Léduc."

" April 9th.

"Yesterday was entirely occupied with affairs of the Physical Society. First a lecture by M. Perrin on X-rays—nothing new at all, but interesting. Then in the afternoon

the exhibition of the apparatus till five o'clock. At seven o'clock a dinner—a little dinner at a restaurant by Ramsay to eight of his French chemical colleagues, from which, at nine o'clock, I hurried away to repeat my experiments at the Société de Physique. Then back to this snug hotel, very tired.

"This morning I was off early to pack up : after which I made two or three calls, and then caught the 12.50 train to Noiseul with a party of about 130 members of the Société de Physique, where we visited the chocolate works of Ménier, and his model farm, in both of which electricity is used for motive power. They have a vast establishment, most beautifully kept. The comfort of the work-people is something quite extraordinary. By five-thirty we were back in Paris, and at six-thirty came the Council dinner of the Société de Physique, to which I was invited, and found myself placed on the right hand of the President. Happily there were no speeches. I met a lot of men whose names and work were well known to me, but whom I had not known personally before.

"To-morrow I am going again to Koenig ; then to some other ateliers about apparatus ; and in the afternoon I shall have M. Boistel with me. On Saturday I have to visit the Sorbonne and afterwards the national laboratory of research at Sèvres, after which I dine with M. Mascart."

In May Thompson gave a Friday evening discourse at the Royal Institution on "Electric Shadows and Luminescence." It began with an account of Röntgen's discovery, and its implications :

"The discovery was singular," he said, "it revealed the existence of a remarkable and hitherto unexpected species of radiation. It added another to the many puzzling phenomena attendant upon the discharge of electricity *in vacuo*. It proved that something, which in the ordinary sense in which those terms are used, is neither light nor electricity, was generated in the Crookes' tube, and passed from it through substances opaque alike to both.

"But that which took the imagination of the multitude by storm, and aroused an interest the intensity of which has not been known to be aroused by any other scientific discovery in our times, was not these facts, but the entirely subsidiary and comparatively unimportant point that to

these mysterious radiations flesh is more transparent than bone."

He showed the experiment of photographing the hand of his little daughter by exposure to the Röntgen Rays, remarking that, "there is nothing new about this part of the subject: it is the old photography; there is no 'new photography.'" (Referring to the popular description of photographs taken by Röntgen Rays as "the new photography.")

He also photographed some metal substances shut up in a box, and various precious stones, some real, and some artificial. At the end of the lecture the photographs were thrown on the screen, revealing his own discovery that real gems were more transparent than paste or glass.

He concluded by saying:

"Whatever these remarkable rays are, whether they are vortices in the ether, or longitudinal vibrations, or radiant matter which has penetrated the tube, or, lastly, whether they consist simply of ultra-violet light, their discovery affords us one more illustration of the fact that there is no finality in science. The universe around us is not only not empty, is not only not dark, but is, on the contrary, absolutely full and palpitating with light: though there be light which our eyes may never see, and sounds which our ears may never hear.

"But science has not yet pronounced its last word on the hearing of that which is inaudible and the seeing that which is invisible."

On May 26th Thompson gave, by request, a lecture to the Oxford University Junior Scientific Club, and chose as his title "Luminescence." He again gave a survey of the different phenomena of luminescence, dividing them into nine different groups, of which he gave descriptions, and illustrated them by the many wonderfully brilliant displays of colour to which the subject lends itself. He dwelt on the luminescence of various gems of which he had made special study from the early days when he paid so much attention to the curious properties of the tourmaline. He gave an account of the Röntgen Rays, and also of the new

rays discovered by himself and M. Henri Becquerel. He closed his lecture by saying :

“ But the one thing that gives to this whole subject of luminescence a singular interest, from the practical point of view, is that by its means we appear to be within measurable distance of the invention of a new kind of artificial lighting. Even in the incandescent gas lighting—which is partially a luminescent phenomenon—the heat waste is very great. But the true luminescent light is a cold light ; the actual rays that will give visible illumination being manufactured without any simultaneous manufacture of heat. So that the luminescent lamp of the future, whatever its shape or tint, will be one giving a pure and a cold light, that will neither poison the air with the fumes of combustion nor over-heat it with wasted calorific vibrations.”

A few days later Thompson received another letter from Sir George Stokes dated May 28th. He too was experimenting on luminescence, and wrote, “ It may be worth while to mention to you a little experiment, though containing nothing new in principle.” He then went on to describe this new experiment, and also an old one which he had made forty-three years before, on the same line of research. In a postscript to the letter he wrote :

“ I may as well mention, in case you should not have seen it, that in the last number of the *Comptes Rendus* is a paper by Becquerel in which he mentioned that metallic uranium shows the remarkable phenomenon, which you and he discovered independently, about four times as strongly as the salts of uranium he had previously used.”

Thompson received also in May the following letter from Sir William Crookes :

“ MY DEAR SILVANUS,

“ Would you be willing to deliver the course of six Christmas Lectures next winter at the Royal Institution ? We want a course on some branch of Physics, and you, as an old Christmas Lecturer [referring to his Bristol days], will understand the kind of thing required by the audience, and, having this good notice, will be able to devise a sufficient

number of experiments to illustrate the course in a manner worthy of the best traditions of the Institution and of the distinguished lecturer. We will leave the selection of the special subject to yourself."

Thompson accepted the invitation and chose the subject of optics, giving, as his title, "Light Visible and Invisible."

The British Association was held that year at Liverpool, and Thompson and his wife were the guests of his cousin, Mr. Isaac Cooke Thompson, who was one of the local secretaries for the Association. The gathering was a brilliant success. Professor J. J. Thomson was President of the Mathematical and Physical Section, and founded his address on the discovery of Röntgen.

Thompson read two papers,¹ which were both fairly long, giving accounts of all the results of his experiments of that year, on Kathode Rays and Hyper-phosphorescent bodies. Sir George Stokes, Dr. Dawson Turner, and Professor Bjerknes of Stockholm took part in the important discussions after the papers.

Towards the end of the year Thompson had before him a difficult task in endeavouring to make the problems of optics interesting to a juvenile audience.

The Christmas lectures at the Royal Institution were very well attended, not only by juveniles, including the lecturer's four little girls, but by their parents, and even such distinguished grandparents as Sir Alfred Garrod and Sir William Crookes. Many members of the Institution helped to swell the number of attenders, who so filled the lecture theatre and gallery that not a seat was left. One boy was heard to say that he would rather go to Professor Thompson's lecture than accept an invitation to a pantomime which was offered to him.

The lectures received extraordinarily full reports in the daily press. *The Daily News* had a leading article on them after the conclusion of the course, in which it said :

"The Christmas lectures for the young at the Royal Institution have never been more fascinating than they are

¹ As reported in *Engineering*, October 16th, 1896.

this season. Of the discourse of Professor Silvanus Thompson on Saturday we have given a fuller report than usual, but no reader is likely to think it too long, and the children who had the pleasure of seeing the marvellous experiments described in it must have found the lecture itself to be all too short. Professor Thompson showed a series of beautiful vacuum-tubes of various forms, and remarked that no discovery was ever made without something going before it, and showed a vacuum-tube containing some mercury which glowed when the tube was shaken, and he asserted that Europe was as much excited by that small instrument nearly 200 years ago as by the recent discovery of Roentgen."

The Standard also gave long accounts, and said :

" Professor Silvanus Thompson on Saturday afternoon concluded a remarkably able ' course ' at the Royal Institution, which was of exceptional interest. The universe, he said in his peroration, was, no doubt, full of vibrations of which we have not as yet the remotest knowledge or the slightest indication. This, however, is true not of light only, but also of many other things. No one had known that the qualities he had spoken of belonged to the Crookes' tube, and yet they had been there for twenty years. ' As year after year passed by, one discovery would lead to another, and thus science would creep on from point to point. So we should gain in knowledge, ignorance being rolled a little further and further back, and we should have light where we now had darkness.' "

These lectures were published as a volume in 1897 by Messrs. Macmillan & Co., and each lecture was enlarged and elaborated by the addition of notes by the author. Mr. Elihu Thomson wrote in November from Massachusetts :

" It is a book which I think will be very useful to the many enquiring youths who cannot be present at your lectures. I wish my boys could hear them. I like the book very much, and think that something of the kind has been needed. I should like to join the Roentgen Society."

Reviewing the book, *The Oxford Magazine* said :

" By a happy combination of lucidity and apt illustration Professor Thompson succeeds in making even the

more abstruse phenomena of Optics intelligible to the lay mind."

The German translator of the book was Professor Otto Lummer, a great authority on Optics, who used the title *Sichtbares und Unsichtbares Licht*. The book was also translated into French later on, when it was in its second edition, to which two more chapters had been added.

The Saturday Review wrote as follows :

"It is delightfully refreshing to get away from the unending stream of text-books with their abrupt transitions from subject to subject, and their dull footnotes on stale researches, of which no one in his senses takes the least notice. And get away from it we certainly do in these lectures of Professor Thompson, which more than accomplish the work of an elementary text-book, and are full of ideas excellent alike for teacher and pupil. The majority of lectures still follow in the old rut of dry definition and drier explanation, with the inevitable result that the pupil gets no real grasp of the subject, though he may sometimes, with their aid, blossom to the dignity of a degree. Refraction, achromatism, polarisation, and the like, are familiar words to many students, but they have the haziest of conceptions attached to them. To describe these things in the simplest language, to introduce all possible analogies, to attach to them the most definite of ideas—this should be the aim of all teachers, and has of late been the method of the best.

Professor Thompson is capital from this point of view. Step by step experiment and theory go hand in hand ; if an experiment is to be explained, then we call on the undulatory theory ; if the theory is to be assisted out of a tight place, then experiment comes to its aid. These lectures may lack the dignity of language, the wide view looking far beyond the narrow limits of the subject possessed by Tyndall's *Lectures on Light* ; 'but Tyndall lost sight of those small intermediate steps, so all-important in making clear the principles of science, and only those who have been 'through the mill' know how to fill up the gaps appropriately. The explanation of refraction by the wave theory, for instance, hinted at rather than developed by Tyndall, is so expanded by Professor Thompson, that, armed with a pair of compasses, a ruler, and the most elementary know-

ledge of theory, the student may work out experiments in a mechanical way."

The second edition of *Light Visible and Invisible* came out in 1910. The two chapters which were added to it at that time were one on Radium, with portraits of Madame and Monsieur Curie, its discoverers, and the other, a lecture on "The Manufacture of Light" given by Thompson to the working men of York at the time of the meeting of the British Association there in 1906. There was a great demand for the book in its enlarged form, and it had soon to be reprinted.

The subsidiary effects of Röntgen Rays, by means of which photographs could be obtained, were at first rather scorned by the physicists, but to surgeons and medical men they seemed to be much the most important part of the discovery, and they were eager to learn more about them.

In March 1896 the secretary of the Clinical Society of London wrote to Thompson asking if he could give to their Society a demonstration and explanation of the Röntgen Rays. This he was very willing to do, and showed all that could then be done by the rays at a meeting of the Society. The members, who included some of the most eminent surgeons of the day, were greatly interested and impressed.

Thompson afterwards received many letters from surgeons and doctors, and took a great interest in the continued efforts made by many of them to develop this new instrument for acquiring surgical knowledge which had been put into their hands.

In May 1897, after more than a year had elapsed since the first publication of Röntgen's discovery, a number of the medical men of London decided to form a Röntgen Society in order that knowledge of advances in theory and practice might be diffused. A small preliminary council was formed, who approached Thompson with the request that he would be their first President. He was then still busy with research connected with the subject, and had just sent in to the Royal Society a paper on "Cathode Rays and some Analogous Rays," which was read in June 1897 and after-

wards published in full in *The Philosophical Transactions of the Royal Society* (vol. 190).

The proposed new Society met with Thompson's full approval; he accepted the office of President, and helped with great zeal in the onerous task of drawing up the constitution. A large number of physicists and others interested in the purely scientific side of the problems joined in forming the Society, though even at the beginning the medical profession contributed most to swell its ranks. Among the Vice-Presidents were Professor Ferrier, F.R.S., J. Hall Gladstone, F.R.S., G. Fletcher Moulton, Q.C., F.R.S. The first Honorary Members were Professor Röntgen, who was much interested in the foundation of the Society, and Sir William Crookes. The first general meeting of the Society was held in June, and the rules were adopted. The election of officers also took place.

As Thompson went that autumn to attend the British Association meeting at Toronto, and was absent from England many weeks, the Röntgen Society decided not to hold their opening meeting until November. This meeting took the form of a *Conversazione*, held in St. Martin's Hall, the President gave his address, and various pieces of apparatus and X-ray photographs were on exhibition. The membership in the first year reached nearly two hundred.

Thompson's presidential address consisted in large measure of an account of the discovery of the Röntgen Rays. He then went on to say :

"No sooner, however, was Roentgen's discovery placed before the world than its immense importance was at once seen and acknowledged. No discovery of our time—or of any other time—has been followed by so immediate and universal an outburst of scientific activity. The revival of interest it has caused in the science of optics has been truly remarkable.

"The electrician seized upon it with scarcely less avidity. Every photographer, amateur and professional, found in it a new point of departure, and hastened to practise the black art of skiagraphy. But most of all did it appeal to the medical profession as affording a means of investigation of the most astonishing power, revealing in the living body

deep-seated structures, which previously could only be diagnosed from the exterior, or else explored directly by the probe or the scalpel of the anatomist. Very shortly also the Roentgen Rays were discovered to possess electrical and chemical properties of a truly remarkable kind, giving scope to the physical investigator, and demanding his most acute discrimination.

“Meantime the nature of the rays themselves gave ample food for speculation and research. Nearly two years have elapsed since Roentgen’s discovery was made public. During that time thousands of workers all over the globe have busied themselves in the new branch of science thus opened out ; and of these thousands a few have been able to make contributions of permanent value to science. Given the discovery, it is easy to follow out its developments :

“ ‘All can raise the flower now
Most have got the seed.’ ”

“As our Society is composed of those who are desirous of aiding and following out that development, it is germane to our purpose that a brief review of that which has been achieved should be made.”

Thompson then dealt with the improvements in the apparatus which had been made during the two years. Addressing himself to a society principally composed of surgeons, the bearing of the invention upon surgery and medicine occupied the most important place in this eloquent, instructive, and scholarly address. Turning to advances in the results attained and in the applications of the discovery, he said :

“We are confronted with a marvellous record of progress. Excepting only the introduction into surgery by Lord Lister of antiseptics, and the discovery of anaesthetics, no discovery in the present century has done so much for operative surgery as this of the Roentgen Rays.”

He ended his discourse thus :

“It is clear, then, that our little Society has an abundant field before it to engross the activities of its members, not only for the approaching winter, but for many years to come. Already there are three journals established—one

in England, one in Germany, one in America—for the publication of observations and discoveries connected with the Roentgen Rays.

“The pioneers have opened the way into the wilderness; not until every corner is explored and charted will the work of our Society be ended. But, while life is short and art is long, science expands without limit or term. But, whether working in a modern laboratory equipped by the foresight and at the expense of an enlightened municipality, as Roentgen did, or whether compelled by force of circumstances to experiment in isolation or obscurity, the scientific worker who patiently tracks out the unexplored pathways of Nature is certain, sooner or later, to succeed in penetrating a little further into the mysteries of the unknown. His work, however unambitious, is not in vain.

“‘Nature never did betray the heart that loved her.’”

During his year of office as President Thompson was diligent in attending its committees, and presiding at its Monthly Meetings generally held at the Medical Society's rooms in Chandos Street, Cavendish Square. The year was a very successful one, both as regarded the papers and discussions and the membership and financial support. The Council were very anxious that Thompson should consent to be elected for a second year, but he could not undertake to give up sufficient time, and he was also convinced that the next President should be a medical man.

The Society continued to flourish, and as a rule the Presidents were alternately medical men and men who were devoted to the purely scientific problems. In 1907 the Presidency fell to the late Mr. William Duddell, F.R.S., one of the most brilliant young scientific men of the day, who had been a student at the Central Technical College, and had also attended Thompson's courses of evening lectures at Finsbury. He frequently consulted with Thompson about the Society, and was most devoted to its interests.

The Röntgen Society was now in a very flourishing condition; it had its Library and its own Journal. Since the discovery of Radium it had altered its rules to enlarge the scope of its studies, and include in addition to X-rays

“allied phenomena in their relation to Medicine, the Arts, and Sciences.”

The last piece of research work shown to the Society by Thompson was in reference to the physiological effects produced by putting the head near a powerful alternating electromagnet.

When preparing Kelvin's biography he found in the *Popular Lectures and Addresses* some mention of earlier experiments upon what he himself had previously noticed, faint visual effects on placing his forehead near an alternating electromagnet, with which he was experimenting.

In 1908 he had written to Sir Oliver Lodge about it, and received the following reply :

“I do not much like the idea of putting my head in an alternating magnetic field. I think it ought to be a steady magnet to give a really new effect.

“A moving or alternating magnet must, of course, induce E. M. F. in conducting tissues, and it is only a question of the amount. The old Volta experiment of zinc and silver on tongue and lip shows that the impression of a flash of light may be caused by very moderate voltage. I am afraid, therefore, that your observation may be only a variant of that.”

Thompson, however, was quite convinced that what he had observed was not akin to the Volta experiment, and continued his research into the cause of the phenomena at Finsbury, and in 1910 he communicated the results to the Royal Society in a paper entitled, *Physiological Effects of an Alternating Magnetic Field*. In December 1911 he received a letter from Mr. A. A. Campbell Swinton saying :

“I was requested by the Council to approach you again to see whether you could not be induced to show to the Roentgen Society your experiments with the alternating magnet on the human head. Great interest was expressed in these experiments, particularly by some of the medical men present, and what was thought was that, if the Society could be allowed to meet one evening at Finsbury College, the individual members might be allowed to put their heads

in the magnet as a preliminary, and we might then afterwards have a discussion on the subject."

The meeting of the Society in Thompson's laboratory took place the following March 1912, and was attended by many well-known medical men.

A year after Thompson's death in 1917 the Röntgen Society decided to endow a Memorial to its first President, and it was resolved to create an annual lectureship, to be called the "Silvanus P. Thompson Memorial Lecture," and that a bronze medal bearing his portrait should be presented to the lecturer.

The first lecture was given in April 1918 at Burlington House by Professor Sir Ernest Rutherford, F.R.S., who in the introduction to his lecture said :

"I feel it a great honour to be asked to give the first of the annual lectures you have instituted in memory of the late Professor Silvanus P. Thompson. . . . I am sure we can all agree that the Roentgen Society made a very fortunate choice in selecting Professor S. P. Thompson as their first President, for he was a man not only distinguished as a teacher, investigator, and writer on technical science, but was, in addition, greatly interested in the advance of pure science, especially in the domain of optics. This is well shown by his contributions on Light, and by that excellent book *Light, Visible and Invisible*, published in 1897. It was his interest in all types of radiation that led him to make experiments on X-rays immediately after their discovery, and, I understand, he was one of the first to obtain X-ray photographs in this country. Subsequently he was able to show that the efficiency of X-ray tubes was increased by the use of heavy elements like platinum and uranium, as anticathode, and made other researches on the effect of a magnetic field on the discharge in a vacuum-tube. With his interest in pure science and its application, it must have been a gratification to him to become your first President, and to guide your infant steps along the path of progress. Apart from his presidential address, his most notable contribution to the Society was an account of his experiments on the physiological effect on the head of a powerful alternating magnetic field, serving as an

illustration of the catholicity of his scientific interest and his versatility. . . .

"In reading again the admirable presidential address of Professor S. P. Thompson to this Society in 1897, before a brilliant audience, and which, we are told, occupied forty minutes, one cannot but recall the exciting atmosphere of that time, and the extraordinary interest that was aroused, in the lay and the scientific mind alike, by the discovery of the Roentgen Rays. Naturally in his address, prominence was given to the medical application of those rays for the advancement of which the Roentgen Society was primarily founded, and for which it has done such admirable work.

"But an interesting account was given also of the ideas at that time of the nature and origin of the new rays—ideas that have in the main received complete verification in recent years."

The two following letters from Lord Kelvin to Thompson should be quoted here, as showing the estimation of Thompson's work on the subjects dealt with in this chapter by his great contemporary, although they have been already printed in the *Life of Lord Kelvin*.

"NETHERHALL, LARGS,

"October 10th, 1899.

"DEAR THOMPSON,

"I have looked in vain in encyclopedias and text-books for something that every one doesn't know regarding the phosphorescence of luminous paint, Canton's phosphorus, etc. : so, as you know more than encyclopedias and text-books put together, I apply to you.

"(1) Can you tell me what is known regarding the effect of temperature? I find, with little copper plates and a glass plate painted with Balmain's luminous paint, that the warmth of my hand greatly increases the glow due to previous illumination; and that, if of two similar plates, equally dosed with light, I keep one for an hour or two warmer by 10° or 20° C. than the other, it glows more brightly than the other till it cools, and becomes darker than the other in a minute or two, when it is cold like the other. Hence it appears that the warmth causes the stored light to be given out faster. I suppose this is well known, but I haven't found it told anywhere that I can remember.

"(2) Is there good information as to the excitement of

ordinary phosphorescence by different parts of a homogeneous spectrum? I have heard it said that the phosphorescent light may be of either shorter or longer period than the originating light. In Stokes's fluorescence he found the fluorescent light always of longer period than the originating.

"(3) Do you know Dewar's splendid phosphorescence of egg-shells and other ordinary solids at very low temperatures? Was it generated by incident light at the low temperature, and did it only appear brilliantly when the temperature was raised? I have been looking through the *Phil. Mag.*, and can find nothing of it.

"(4) Do you know what Edmond Becquerel did in respect to effect of ultra-red radiation on phosphorescence? I remember him telling me of it, or showing it to me a great many years ago, but I can't remember exactly what it was.

"(5) Do you know anything of Stokes's experiments on the subject?

"Yours very truly,

"KELVIN."

Thompson's reply to this letter is unfortunately not to be found, but the sense of it may be inferred from Kelvin's letter of a few days later:

"NETHERHALL, LARGS,
"October 14th, 1899.

"DEAR THOMPSON,

"You have splendidly verified the validity of my applying to you for information 'not to be found in encyclopedias or ordinary text-books' on a very interesting and important scientific subject; and I am most grateful to you for your letter of the 11th, and the copy of your Oxford Lecture. I feel now that, with your Oxford Lecture and your *Light Visible and Invisible*, and the exceedingly interesting answers to my questions in your letter, I have all that is known on the subject and as fair a view as possible towards the *omne scibile*. •

"In respect to Becquerel's effect of the extreme red, I thought it likely that the explanation would be what you tell me it has turned out to be.

"As to Stokes, I hope to see him at Cambridge at the end of the month, and to extract all I can from him, which I believe will include something vitally important not yet published.

"I hope to see yourself still sooner, as we are going to London on Monday next for the opening of Parliament. I would like to come and see you, if you will allow me, in Finsbury one of these days ; and to see anything you could quite conveniently show me in the way of phosphorescence or the Phillips phenomenon, or any other of the splendid things you may chance to have at hand.

"Will you give me a line, addressed Fleming's Hotel, Halfmoon St., Piccadilly (where we shall arrive on Monday evening), to say if there is any time in the forenoon of Wednesday, Thursday, or Friday (18th, 19th, or 20th), when it would be convenient for you that I should come.

"As to the Electrical Engineers' dinner on December 6th, I am afraid I must not come. I expect to be settled here for the winter by that time. . . . However, we can speak of this when we meet, as I hope we shall, next week.

"Yours very truly,

"KELVIN."

CHAPTER X

WORK FOR THE INSTITUTION OF ELECTRICAL ENGINEERS AND INTERNATIONAL ELECTRICAL CONGRESSES

SILVANUS THOMPSON was proposed as a member of the Society of Telegraph Engineers and Electricians by Professor George Carey Foster, F.R.S., in the year 1882. He was elected that year, and in 1883 read his first paper to the Society, "Remarks on Contact Resistance," afterwards printed in the Journal.

That same year the Society changed its title to the one it now bears, "The Institution of Electrical Engineers." Thompson was not, however, able to attend its meetings with any regularity until he removed to London in 1885. These meetings were at that time held in the Hall of the Civil Engineers in Great George Street, Westminster, and it was not until many years later that the present institution building on the Embankment was purchased.

In 1886 he was elected a member of the Council, on which he continued to serve after he had passed the Presidential Chair. He was also elected on to many of its committees, and, as Chairman of the Research Committee, he had the pleasure of initiating many researches, some of which have proved most useful to the electric industry.

He frequently took an important part in its discussions, and in 1888 contributed one of his remarkable historical papers, "The Influence Machine from 1788 to 1888," which, Professor Ayrton said, "could have been written by no other man." Another noteworthy communication was on "Rotatory Converters," which he gave in 1898.

After he had held the office of Vice-President for several years, it seemed probable that the choice of the Council

would fall upon him to be President in 1899. The office is, as a rule, held for only one year, and during 1898 it had been filled by Sir Joseph Wilson Swan.

The year 1899 was a remarkable one for electricians, as it was the centenary of the invention of the Pile by the great Volta. The Italians were celebrating it by holding an Electrical Exhibition at Como, his birthplace. His tomb and the mausoleum erected to his memory were situated near the town.

The International Electrical Congress had arranged to hold its next meeting at Como in September, and Thompson had planned to be present, and during the previous winter had been taking conversational lessons in Italian.

Ever since his first visit to Italy in 1892, he had been keeping in touch with several Italian electricians whom he had met then, and subsequently, at Paris and Frankfort during meetings of the Congress.

His work on the Dynamo was well known in Italy, as his books had been translated into Italian.

In November 1898 he was made foreign member of the "Associazione elettrotecnica italiana"; this was announced to him by Signor G. Colombo (afterwards Commendatore, and Senatore del Regno) of Milan, who wrote from the Reale Istituto Tecnico Superiore: "We consider it a very great honour to have you among us in the Associazione, and are very glad that our Statute admits foreign members. We will inscribe you in the section of Milan."

In 1891 Thompson had already been made a Member of the Council of the Société Internationale des Electriciens, and a Vice-President of the Electrical Exhibition at Frankfort, where the Congress was held that year. Accompanied by his wife, he spent several weeks in July of that year there. He, Professor Ayrton, Mr. Preece, Dr. Hopkinson, Professor Fleming, and Mr. Kapp were appointed on the Commission for the examination of the exhibits. The Exhibition was one of great interest; it was lit by an electric current, brought from Laufen, where a fall in the river Rhine provided power to work the dynamos, and the current was carried by overhead wires to Frankfort. Visitors

to the Exhibition had also the privilege of riding on the first electric tramway.

Owing to the Exhibition, the subjects taken up by the International Congress were of a more technical character than they had been on previous occasions. During its sittings Thompson read three papers in different sections; one, the most important, on "Alternating Currents," he gave in German. This Congress was the means of his being introduced to many of the electricians of Europe, German, Russian, Italian, Swedish, with whom he afterwards maintained very friendly relations.

It ended as usual with a banquet, to which (not as usual) the wives and daughters of members were invited. This was given in the Palmengarten, the small Crystal Palace of Frankfort.

The President of the Congress, Dr. von Stephan, Postmaster-General of Germany, presided, and many speeches were made. Thompson had been asked to propose the toast of "German Science."

He spoke partly in German and partly in English, and in the course of it made an eloquent appeal to the members that science should be made more and more international, and that scientific men should rise above the jealousies of diplomatists and traders, and co-operate for the benefit of mankind, ending with the words "Lebe hoch! die Deutsche Wissenschaft." This speech was received most enthusiastically, members of the Congress coming from all parts of the hall to congratulate the speaker.

The following extracts from letters to his wife during her absence from home in the spring of 1899 refer to matters connected with the Institution of Electrical Engineers.

" March 23rd, 1899.

"Thursday's meeting at the Electrical Engineers went off capitally. Mrs. Ayrton [a former Finsbury Student] delivered her paper in capital style, and the experiments worked well. She has made a really important discovery as to the physics of the arc—namely, that the hissing, when it occurs, is due to oxygen getting to the white-hot carbon surface. There were a lot of ladies present. Mrs. Swan,

Mrs. Mordey, Mrs. Maxim — also Edie and Barbie [the Misses Ayrton]. Everybody seemed a little bit excited, realising that it was a somewhat unusual occasion. I spoke afterwards, and congratulated Mrs. Ayrton on having found the clue and furnished a disproof of one of the fallacies which I had had more than once to contend against in that room. Swan presided, and looks in perfect health.

“I have had the good fortune of getting an Italian lesson this week: for there called upon me yesterday Signor Pescetto of Turin—an old friend of Ferraris¹—who speaks scarce a word of English, and not much more French.

“I took him to lunch at Spiers and Pond’s Restaurant in the City, and found a table where was an Italian waiter. I talked Italian—after a fashion—with him for two and a half hours! He intends to be at Como; and had heard that you intend to be there. He sent his compliments to you in advance.”

“April 11th, 1899.

“I have some news for you to-day. This afternoon the Council of the Electrical Engineers unanimously elected me as their choice for the Presidency, though, of course, the formal election by the General Meeting does not take place until a month hence.

“It was, I am told, a foregone conclusion that the nomination would be unanimous. It is a great honour; and to-night I have had the responsibilities of the office rather than its dignities upon my mind.

“However, the Council is pulling well together, and I shall be well supported. I am glad that there is an end to uncertainties.

“I am not quite sure that I can meet you at Paddington on Thursday. If I can I will. Thursday evening is the continued discussion of Mrs. Ayrton’s paper at the I.E.E. Will you come to this?”

It was the custom for the newly elected President of the Institution to receive the guests at the Annual Soirée, of the members and their friends, which was generally held at the Natural History Museum, South Kensington, in the month of June.

¹ Mrs. Thompson had translated from the Italian some of the electrical publications of the late Professor Galileo Ferraris, first President of the *Associazione Electrotecnica*, who died in 1897 at the age of forty.

It was with some consternation that Thompson and his wife received, towards the end of May, a proposal from Colonel Crompton, the commander of the Electrical Engineers' Volunteer Corps, that the volunteers should on this occasion provide a guard of honour for the President and his wife at their reception. This would have been an innovation, and would have seemed very incongruous in the case of a Quaker President.

The following letter explains the feelings with which Thompson regarded the proposal.

" May 27th, 1899.

" DEAR COLONEL CROMPTON,

" I am quite sure that your letter of the 20th instant was intended to be for the good of the Institution, and not for the purpose of compromising me.

" But you must surely remember that from the very first I have declined to have anything to do with the Electrical Engineers' Volunteer Corps, and that on the occasion when it was first suggested I was the Member of Council who on principle opposed its formation. On that occasion I was in a minority of two.¹ My views on this matter have been openly known from the first, and the circumstance that by the good-will of my colleagues I have been chosen President for the current year does not alter them. During my year of presidency, while I shall certainly defer to the wishes of the majority, and so far sink my own views as to remain silent in my opposition to the movement of which, since Dr. Hopkinson's lamented death, you have become the head I shall also equally certainly decline to take any new step, in promoting that to which, as a matter of conscience, I am opposed. I am fully aware that your efforts are unselfishly devoted to that which you believe to be for the good of the Institution.

" While I appreciate gratefully your courtesy in thus consulting my wishes before moving in this matter, I hope that, under the circumstances, you will not put me into the painful position of having to oppose any suggestion that might emanate from you. Believe me, dear Mr. Crompton, yours always sincerely."

Mr. Crompton at once replied in the most friendly manner,

¹ His old friend, the late Professor G. Carey Foster, F.R.S., was the other.

abandoning the proposal, saying that it was intended as a special honour for this occasion. He also remarked that he had understood that the Quaker, John Bright, had said : " If you want to prevent war, be prepared for it." Thompson in his letter of thanks, retorted to this last remark, " I knew John Bright, and *you* did not ; his actions did not tally with the words you ascribe to him."

This was not the only time in the career of Thompson that he was uncompromising in his attitude towards militarism, and this position which he took up, and maintained throughout his life, was on at least one occasion the cause of his losing the chance of an important academic promotion. It was with extreme regret that he saw the English Universities admitting the study of military tactics into their curricula and promoting that spirit of militarism which he had observed to be producing such baneful results on the continent of Europe.

Thompson was no mere *passivist* ; he believed in trying to be a *pacifist* by the promotion of international understanding and intercourse, and during his presidency he was able to inaugurate, in a most successful manner, one means to help to bring this about.

His gift of tongues, his constant reading of foreign scientific journals, his frequent correspondence with men of science all over Europe, had placed him in an almost unique position for the promotion of these ideas of international friendship. He had felt for many years that the limitation caused by a far too narrow and insular outlook on electrical science was gravely to the disadvantage of the British electrical engineers. So when he became President he determined to arrange excursions to various centres of electrical development abroad, in the hope of educating at least many of the younger members of the Institution in knowledge of what was being done on the Continent.

He proposed that they should visit Switzerland first, and undertook to get permission from some of the proprietors of the largest electrical engineering works in that country to allow members of the Institution to see them.

The proposal was taken up by several members of the

Council, and a committee was appointed to arrange for a visit to Switzerland in the beginning of September.

The *soirée* of this season at which Thompson presided took place at the Natural History Museum, and was one of the largest that had been held. Among the members present were large numbers of his old students and their wives and fiancées, and many were the introductions which had to be made. The scientific circle of London was well represented, and personal friends of the Thompsons also came to congratulate them on the new position of honour.

In July Thompson received a letter from Professor Oliver Lodge, asking if he could give a lecture to a Students' Society in Liverpool during the autumn.

His reply was as follows :

"I wish I could say *yes* to your invitation to lecture to your Students' Society ; but I must not. Next autumn I shall have a very, very heavy time. For, not only have I the presidency of the I.E.E. on my hands—no light duty, with three committees on an average every week—but my college staff is almost entirely new, Mr. O'Keefe being the only one who has been with me as much as one session ; even my lecture preparer is new. Hence I shall have no leisure, and dare not add to engagements. The question is not one of remuneration—for, except Royal Institution lectures, I have taken no fee for outside lectures for several years past."

Thompson's practice as a Consulting Electrical Engineer had grown considerably during recent years, and of course his position as President of the Institution brought more work of that kind to him. He was, however, obliged to decline a good deal of it on account of his heavy duties at Finsbury, although he had obtained permission from the City Guilds Committee of the College to undertake a limited amount of such outside work. He was very frequently consulted about new electrical schemes and undertakings by public bodies throughout the country.

The cessation of his college duties early in July found him immersed in preparations for the Swiss visit, for the carrying out of which a strong committee had been formed,

but the initial approaches to the Swiss manufacturers had to be made by himself.

The Secretary of the Institution, Mr. W. G. McMillan, was invaluable as an assistant in this scheme. But on July 8th he wrote to Thompson that he was still much exercised in his mind on the difficulties of organising a trip across Europe for about two hundred people, many of whom had never been abroad before, and spoke no language but their own. Thompson came to the rescue, and about a week later Mr. McMillan, who had been sent out to Switzerland to make final arrangements, and go over the ground, wrote from Zurich that all plans seemed to be going forward satisfactorily.

Thompson spent August with his family at Whitby, taking a good rest, and passing many hours sketching in the picturesque old town.

On September 1st he and Mrs. Thompson travelled to Basle, the rendezvous for those taking part in the Swiss Reunion.

The excursion was a success from the first; people seemed determined to make the best of any little *contre-temps* which occurred, and the programme was carried out without a hitch. The power station at Rheinfelden and numerous electric engineering works were visited.

One of the most interesting excursions was to the Jungfrau Electric Railway, then in course of construction and completed as far as the Eiger Glacier, though not then open to the public. The party were taken up by train as far as the line was laid, and were also allowed to inspect the works of the Railway.

At the conclusion of the Swiss Reunion Thompson and the Committee were quite satisfied with the usefulness of this new departure in the history of the Institution.

From Switzerland the Thompsons went on into Italy, and had a few days of quiet at Bellagio before the commencement of the International Electrical Congress at Como. While staying there they visited Signor Colombo in his beautiful villa on the opposite side of Lake Como, and also made the acquaintance of several of the Italian

members of the Congress, who were staying on the lake side.

A great disaster had befallen the Exhibition at Como during the month of July, when it had been almost entirely destroyed by fire and large numbers of most precious relics of Volta had been burnt. With undaunted courage, however, the Italians rebuilt their Exhibition, and from all over Europe scientific bodies and individuals did their best to help, by loans of relics or manuscripts relating to Volta's work.

Thompson, as President of the Institution, had been appointed a member of the Comitato Onorevole of the Exhibition, and he had at once written to Sig. Cadenazzi, the Mayor of Como, offering to lend MSS. and letters from his collection. His letter making this offer written to the Mayor of Como was printed *in extenso* in the little Como newspaper, *La Provincia di Como*, of July 21st, with many expressions of appreciation of his sympathetic action.

King Humbert and Queen Margharita, accompanied by the Crown Prince and Princess, came to Como to reopen the Exhibition, and, their visit coinciding with the opening sitting of the International Electrical Congress, they also attended its first meeting.

The opening address was given by Professor Augusto Righi, of Bologna, and then a paper was given by Thompson on Magnetic Images. He gave this in Italian, and it was afterwards published by the Associazione Elettrotecnica Italiana at Milan in 1900 under the title *Intorno alle Immagini Magnetiche*.

A few days later the Physical Society of Italy also held a Congress at Como ; at its second session Thompson took part in a discussion on a paper on certain phenomena of magnetic currents given by Professor Donati of Bologna.

On the Sunday following the Congress, Thompson and his wife drove out to see the tomb of Volta at Camnago, a few miles from Como. Here, seated in a corner of the little graveyard, he made a very successful water-colour drawing of Volta's tomb amid its picturesque cypresses.

The following week was occupied by excursions, to visit Electric Stations at Paderno, Vizzola, and Milan. At the latter city a meeting of the Associazione Elettrotecnica, of which Thompson's good friend Signor G. Colombo was President, took place. He attended some of the meetings, but, after this surfeit of Congresses, was glad to get home to take up his heavy duties of the autumn. A few months later he received from Como the "Diploma di Benemerenzza" for his work in connection with the Exhibition and Congress.

The Presidential Address to the Institution was given on November 16th, 1899.

It was devoted to the subject of the future work and development of the Institution.

"The advancement of Science," he said, "depends largely upon the initial co-operation of science workers and of the Societies founded for the diffusion and co-ordination of knowledge. Rightly conducted, the influence of such an Institution as ours, both within and without its borders, is very great.

"It may do a real and lasting service in directing attention to the things that make for progress. The development of our electrical industry is determined by international factors, supplies of raw materials, cost of transport, relative technical skill and training of our designers and manufacturers, in this and other countries."

These extracts may serve to show the trend of his address.

In proposing a vote of thanks to the President, Mr. W. M. Mordey said :

"Now we see him in a new capacity—as a prophet, for to-night he has departed from the usual practice. He has dealt, not with the past—with which he is very well competent to deal—as are all successful prophets—but with the future. This has been a fighting address. Dr. Thompson has peered into the future, he has seen things that are happening in that future, and he has come and told us what those things are."

Writing in *The Journal of Electrical Engineers* many years later, Dr. Alexander Russell said of this Presidential

Address: "Much of the advice given in it has been adopted by the Institution."

At the annual dinner held in December, Thompson was supported by Lord Kelvin, Professor David Hughes, Sir James Crichton Browne, Sir William Roberts Austen, Sir William White, Sir Henry Roscoe, Professor Perry, and about 250 members. The aged Lord Kelvin proposed the toast of "Science," and pointed out the advantages which electrical engineers had derived from a knowledge of mathematics. Sir W. Roberts Austen and Sir Henry Roscoe responded.

When the year of presidency came to an end Thompson was succeeded by Professor John Perry, F.R.S., who enthusiastically carried on the idea of the foreign excursion. This year the obvious place to visit was Paris, where a huge International Exhibition was being held. The American Institution of Electrical Engineers was also contemplating an excursion to France, so the two Institutions agreed to make it a joint affair. There was some fear on the part of a few members that the English Institution would not be received in a friendly manner by the French owing to our Boer War then going on, which was so unpopular in Europe.

Happily these fears were groundless, for the scientific men of Europe, gathered in Paris for numerous congresses, rose above the coldness felt towards Britain by those who had no international bond.

The President of the American Institution was Professor Carl Hering, a man very popular with English electrical engineers. A special steamer was arranged for, and the journey from London of the two united excursions was a very lively one. Thompson was accompanied on this occasion by his eldest daughter Sylvia, as well as by his wife. Professor Ayrton was accompanied by Mrs. Ayrton, now an honorary member of the Institution of Electrical Engineers, the first woman to be admitted, and their two daughters. The two families had both chosen to stay in the quieter part of Paris, the Quartier Latin. The joint meetings of the American and English electricians were

held in the Exhibition, where each nation had its special pavilion erected for such and kindred gatherings.

The whole of each day was spent in the Exhibition. Meetings for discussion were held in the mornings, and the afternoons were devoted to the visiting of the electrical exhibits under the personal conduction of French, American, or English engineers. There were various receptions in the later afternoons, and of course several banquets.

One of these given by some of the American electrical engineers was a very lively occasion. In American fashion the guests collected the signatures of those present by writing on the back of the menu cards. Professor Perry had unfortunately been prevented from being present, and an empty seat marked his absence. In the place where his signature should have appeared, Thompson rapidly drew on each menu a small caricature labelled "Professor Perry's Ghost." It was really unmistakably like him, and caused great amusement.

In June 1901 the Annual Excursion of the Institution was to electrical works in Germany. Thompson and his wife were again members of the party. Their first halting-place was Brunswick, then they went on to Berlin, where they were most hospitably feasted and entertained by the heads of the great German electrical companies, who also opened their works to the inspection of the British engineers.

After leaving Berlin the excursion party visited Leipzig and Dresden, and many of them continued the trip into Saxon Switzerland. Thompson was, however, obliged to return to his duties in London, and cut short the merely pleasure part of the excursion.

In the spring of 1903, the anniversary of the death of Volta, the Institution visited Northern Italy. The President of the year was Mr. Robert K. Gray, one of the most generous benefactors of the Institution.

Thompson wrote several letters to his wife, describing the excursion, as she was unable to accompany him on that occasion. He went to Como via Zurich, where he spent three days visiting works in order to get the latest informa-

tion about the progress of dynamo construction for the new edition of his book. The weather was cold and snowy in Switzerland, and he contracted a severe chill, which developed into a mild influenza attack at Como, and much hindered his enjoyment of the excursion.

He wrote from Como, April 2nd:

"I reached this place at 2.30 yesterday, and spent the afternoon on the hill-top above Brunate in the sunshine—a welcome change after the snowstorms and winds at Zurich. I gathered blue bell-gentians, and periwinkles, and vetches, and primroses, and green hellebores. It was lovely. In the evening after dinner Poggi looked in: [Cencio Poggi, Director of the Como Museum], and I am to spend most of to-day with him. The Editor of the *Electrical Engineer* is here; and Blaky writes me that he will be here to-morrow, so we are gathering up. Sir John Wolfe Barry was on the train yesterday—on his way to Brindisi."

"April 4th.

"At 6.30 this evening all our party will arrive, and then good-bye to much time for writing. The Municipality is going to send the city band to greet us on our arrival with musical honours, and will play in the square each evening. We are also to have the square illuminated in honour of our presence. Signor Franchi, Sindaco di Camnago has just called, to talk over the ceremony of Sunday morning, when we are to put a wreath on Volta's tomb."

"April 5th.

"This is Sunday afternoon, and almost all of our party have gone up to Brunate, so that the hotel is very quiet. We had a fine, beautiful warm morning for the drive to the tomb of Volta. Sindaco and Signora Franchi and Professor Alessandro Volta all asked after you, and begged to send their salutations to you. We presented our wreath, and the students (per Mr. Hewett) presented a bronze shield.

"Speeches were made by Mr. Gray as President, by me, by Mr. Gavey, and by Mr. Hewett. In reply we had an admirable speech from Sig. Franchi and another from Professor Volta. The excursion to the Valtellina to see the electrical plant delighted everybody. I did not go, for I was feeling shivery from a chill, caught in Zurich—I think. So I stayed in Como, kept warm, and took quinine. To-day I am all right. I am going to the Biblioteca to see a copy

of Gilbert's *De Magnete* that they have, and then on to the Museo Civico, where at 5 o'clock tea is to be given by the Sindaco.

"Gray makes a perfect leader for the party—does just the right thing at the right time, and pays the utmost attention to little details of courtesy. He speaks French fluently, and Italian a little. To-morrow we go on to Milan via Varese. There we shall see Senatore Colombo, who has not yet been with us."

In *Page's Magazine* an account was given of the visit of the Electrical Engineers to Italy. It says, in relation to the ceremony at the tomb of Volta: "Dr. Silvanus P. Thompson then delivered an eloquent address in Italian, which was listened to with rapt attention, and was much appreciated," then follows "a free translation" of it. In his tribute to Volta's genius, Thompson said of him:

"Truly he was more than an inventor: he was a scientist of the first order, an investigator of great genius, who accomplished many conquests in many departments of physical science; who did many things, but who touched nothing without adorning it."

His peroration was fine, and loses by translation:

"If Italy can boast of the names of Galileo and of Leonardo da Vinci, we can also boast in England of Gilbert, the father of magnetism, of Newton, the creator of natural philosophical mathematics. You Italians have Volta, we are proud of Faraday. But neither Galileo nor Newton, nor Volta, nor Faraday belongs exclusively to one nation. Great men of such a kind belong to the whole world, and we pilgrims of science gather once more round the tomb of Volta, great benefactor of humanity, in order to render our tribute of reverent knowledge and of universal recognition."

While in Milan Thompson and his friend, Mr. W. M. Mordey, managed to find time to spend two evenings enjoying Italian opera at La Scala.

The expedition to Paderno to visit the great power-station, he describes as follows:

"You will remember Paderno; first we went over a big silk-mill electrically driven. We had a marvellous

al fresco lunch in the garden of the old village hotel, then we drove down, in ramshackle brakes, to the place where we dismounted and walked down to the canal—you will remember the old canal of Leonardo da Vinci—and the lovely walk all along it through the woods to the power-house at Paderno. The power-house is quite filled now with its set of machinery—all by Brown—and looks magnificent. All our party were delighted with it. Brown himself came over from Baden for the day to meet us.”

“April 11th.

“The trip is over now, and the party is dispersed. We had a fine excursion to Vizzola yesterday, followed by a visit (which tired me much) to Tosi’s Engineering works at Legnano. However, I enjoyed the final banquet given by the Associazione Elettrotecnica Italiana, at which I sat next to Colombo. It was a great success. I made a speech in honour of the two Associations, and of eternal amity of nations. It was the best I have made in Italian, and I felt quite at ease, very differently indeed from the time four years ago.”

As he was very weary and feeling far from well, Thompson decided to spend Easter quietly at Varese. He wrote from there :

“This is a most lovely place, just between the extremities of the Lakes of Maggiore and Lugano. The view of the Monte Rosa range across the little Varese lake was most exquisite. My room on the second floor looks out over a lovely garden with pines and cypresses and palms and lemon-trees, then the tranquil little lake, and again beyond are low purple hills, above which lies a magnificent panorama of snow summits.

“It has done me a world of good to come to this tranquil spot to rest. I have spent all Sunday quietly sitting in the garden, basking in the blazing sun. This is the first really hot day that we have had. I have spent my time reading Dante: the first time I have even tried to read him in the original—and he is quite easy to follow. I have come across many interesting passages, including the one which Tennyson alluded to, ‘This is truth the poet sings, that a sorrow’s crown of sorrow is remembering happier things’:

“‘Ed ella a me, “Nessun maggior dolore
Che ricordarsi del tempo felice
Nella miseria.”’

“I return on Wednesday for one night to Milan, whence I shall go to visit the electrical works at Val Tellina which I missed. Then on to Paris to meet M. Boistel” (Translator of his *Dynamo* and *Electromagnet*).

In Paris he attended a meeting of the Société de Physique, and visited M. Curie’s laboratory for some experiments on radium.

In 1907 Thompson was asked to be President of the Engineering Section at the British Association Meeting at Leicester. His address consisted, largely, of a plea for a knowledge of pure science as the best equipment of the engineer. He also gave a résumé of what was being done at that time for the education of the young engineer, rejoicing at the gradual disappearance of the premium system.

“In the engineering industry,” he said, “Great Britain is slowly following the lead taken in America, Germany, and Switzerland in the recognition afforded to the value of a systematic college training for the young engineer, though there is still much apathy and even distrust shown in certain quarters. Yet there is no doubt that the stress of competition, particularly of competition against the industry and the enterprise of the trained men of other nations, is gradually forcing to the front the sentiment in favour of a rational and scientific training for the manufacturer and for the engineer. As William Watson, in his ‘Ode on the Coronation,’ wrote in a yet wider sense of England :

‘For now the day is unto them that know,
And not thenceforth she stumbles on the prize;
And yonder march the nations full of eyes.
Already is doom a-spinning. . . .’

“Truly the day is ‘unto them that know.’

“Knowledge, perfected by study and training, must be infused into the experience gained by practice: else we compete at very unequal odds with the systematically trained workers of other nations. . . .

“If the institutions, schools, colleges, where engineering training is offered are but rightly developed and co-ordinated the engineers of Great Britain need have no fear as to holding their own against the trained engineers of other countries. It is for the employers to make use of these

institutions, and to show that sympathetic interest in their efficiency which is essential to their full success."

Of his work in the section Thompson wrote to his wife, who was in Switzerland :

"For the last two days, I have been very full up—tied to the chair. The meeting of the Association has been a great success ; all the local arrangements have been wonderfully perfect, thanks, mainly, to Mr. Colson's excellent powers of organising. Duddell's lecture on the Arc and Spark in Wireless Telegraphy was a most brilliant one. Lodge proposed, and I seconded, the vote of thanks. Sir David Gill's presidency is the right thing in the right place. I doubt whether I can get away on Tuesday from Leicester. The work of the section is going to run over to Wednesday, and one of my Vice-Presidents has gone already. I wish I were back with you and the girls at Wengen."

During this year Lord Kelvin had been President of the Institution of Electrical Engineers for the third time, having held the office in 1874 and 1889. On December 17th he died at Largs, aged eighty-three. In memory of his work, and of his connection with the Institution of Electrical Engineers, a Kelvin Lecture was founded, and Thompson was asked to give the first.

It was delivered on April 30th, 1908, and printed in the Journal of the Institution, and will be referred to in a later chapter.

In 1912 Thompson gave to the members of the Institution another of his important contributions to the science of Electrical Engineering. This was on the occasion of the Annual Summer Excursion, which that year was held in Scotland. In Glasgow, where there was already a strong local branch of the Institution, meetings were held at the Technical College and the Glasgow University.

In the latter building Thompson gave a lecture on "The Magnetism of Permanent Magnets." In a report of the meeting in *Electricity* of June 21st we read :

"After alluding to Lord Kelvin's work on this subject he proceeded to outline the advances that had taken place

during the last quarter of a century, and the possibilities of new alloys in the near future. Professor Thompson's lecture was one of the most interesting papers of the Convention. Delivered almost without notes (they consisted of a few words written on cards, which he held in his hand) and with a fluency and charm which few lecturers possess, he made the subject almost absorbingly interesting.

He spoke for an hour and a half to an audience which contained some laymen and many ladies; and the address was delivered with such perfection of phrasing that it could have been reprinted *verbatim* without showing any looseness or redundancy. The attention of the whole audience was held without intermission; and the applause at the finish was more like the usual appreciation of a political oration than a tribute to an exposition of so dry and obscure a subject as permanent magnetism."

For some years Thompson was on the Committee of the Institution for defining and deciding upon the important question of "Nomenclature" of which Mr. A. P. Trotter was chairman. This committee worked hard, and spent hours over lists of definitions, sifting all the numerous foreign lists.

The beginnings of the nomenclature of electrical units dated back to a paper read at the British Association in 1861 by Sir Charles Bright and Mr. Latimer Clark. This led to the formation of a Committee on Electrical Standards, which in the course of its six years' labour fixed many of the important names, such as *ohm*, *volt*, *coulomb*, etc.

In 1881-2 the Paris Electrical Exhibition drew large numbers of electricians to that city, and the first really International Congress of Electricity was held. It was formed of a body of delegates sent officially either by Government departments or by scientific institutions. The foreign Vice-Presidents were Lord Kelvin, Signor Govi, and Professor von Helmholtz. Thompson was present, but was not a delegate. At this Congress the name of the unit *weber* was changed to that of *ampère*, on the proposal of Von Helmholtz. The Second International Congress, again held in Paris, took place in the year 1889, when there was again an Exhibition going on. Thompson and his wife were both

present, and the President on this occasion was Mr. Thomas Alva Edison, then in the zenith of his fame.

In 1891 the International Congress met at Frankfort, an account of which has already been given. Thompson was present in Chicago in 1893, in Como in 1899, Paris 1900, but not at St. Louis in 1904, when a new departure was made for securing the co-operation of the Electrotechnical Societies of the world, and the Institution of Electrical Engineers was asked to undertake the inauguration of the organisation of an Electrotechnical Commission. The delegates of fourteen countries were called together in 1906 under the presidency of Mr. Alexander Siemens. Lord Kelvin was elected first President of the International Electrotechnical Commission. Each country which had an Electrotechnical Committee had the right to send delegates, and each country was represented equally, and had equal voting power. The first Commission met in London in 1908. Lord Kelvin had died in 1907, and M. Mascart of Paris, who should have succeeded him as President, also passed away in August 1908, so Professor Elihu Thomson was chosen. In 1910 an unofficial conference was held in Brussels under the presidency of Professor Eric Gérard of Liège, and a small committee was formed to discuss international nomenclature, and to meet between the times of holding the International Congresses. Thompson was elected to represent the British Committee, and the first small committee was held at Cologne in May 1911. Dr. Budde came from Berlin, M. Brunswick from Paris, Thompson from England, and M. Eric Gérard from Belgium took the chair. The agreements made then were subsequently confirmed at the next meeting of the whole commission at Turin in September of the same year.

In Turin 1911 a Universal Exhibition celebrating the first fifty years of Italian autonomy was being held, also the International Congress, at which nineteen countries were represented. Thompson and his wife went there in September, and he was again appointed to serve on a Jury, for scientific instruments in the Exhibition. The Congress was organised by the Italian Electrical Society, and was

supported by the International Electrical Commission. The membership was about five hundred, including Government delegates and those from technical societies. Professor Elihu Thomson, the President of the Commission, was there, and the Italian Committee spared no pains in making the meeting a great success, and also one of social pleasure. Thompson contributed a paper in Italian (described as *lucido* in the local press) on Rotating Transformers. It was discussed in Italian and German, the proceedings being interpreted into French for the benefit of those who did not understand the former languages. Many old acquaintances of the Thompsons were present, among them the venerable Professor Pacinotti and his wife.

At a meeting held in honour of Pacinotti, when a testimonial was presented to him, Thompson made a speech in Italian. It had been due to Thompson's drawing attention in his *Dynamo Electric Machinery* to the invention of the earliest form of ring dynamo by Professor Pacinotti that the fame of the latter had spread throughout Europe, and in his reply speech the old man acknowledged this most touchingly.

Many of the delegates stayed in the same hotel, and during the blazing hot days of that September frequent informal discussions went on in the shady courtyard, some of these lasting on into midnight or early morning hours. The Congress will be remembered for the great cordiality which prevailed among all the delegates.

Not long after the Turin Congress the honoured Professor Pacinotti passed away at Pisa, where he had lived and worked for many years. Thompson had first become acquainted with him at Pisa in 1892, when he called on him at the University. In his notes on the visit he says :

"Professor Ant. Pacinotti lectures in his nonchalant style to nine youths. He has, besides ordinary physics, to lecture on agricultural physics and hydraulics twice a week. No laboratory work either of professor or students visible. He showed me his original machine of 1860, also his notes made 1858-9, wherein the idea of the ring is developed, the notion being commutation without disjunction. Sketches

show several devices for having two circuits (or more) from brush to brush, of which only one at one time broken. Original machine runs on cone-pivots, and has wheel-contacts. It ran very well with one bichromate cell. He showed me Note D in De la Rive's *Electricity*, which he said had set him speculating in 1858. He was then but just a student helping his father."

Having always kept up his interest in Pacinotti and his work, Thompson willingly undertook the translation of his *Description of a Small Electromagnetic Machine of Dr. Antonio Pacinotti* (extract from the *Nuovo Cimento* of June 1864), which was bound up with the French translation of Professor Paul Janet, the German of Professor Gisbert Kapp, the Latin of Signor P. Rasi.

In 1912 Thompson read a paper to the Institution of Electrical Engineers entitled, "The Aims and Work of the International Electrotechnical Commission," in which he gave an account of what had been done by it, and of what was still to be accomplished. By that date twenty-two countries were affiliated to the movement. He closed his paper with these words :

"Last, but by no means least, these regular international gatherings, during which national prejudices are laid aside, and at which many lasting friendships are made, between electricians of different nationalities, must undoubtedly be a not unimportant factor in furthering the peace of the world."

Professor Elihu Thomson was succeeded as President of the Electrotechnical Commission by Professor Budde of Berlin, the President also of the small committee which met at Cologne in the spring of 1913. Thompson was again appointed delegate of the British Government for the second plenary meeting to be held at Berlin in September of that year. Colonel Crompton wrote to him in August :

"I hope you will be able to come to the Berlin meeting. You know how much I count upon you. I know it is hard

to interfere with your holidays, but you are such a good international diplomatist that your presence will be of great value to us in trying to get forward."

During that summer Thompson was spending his holiday in the Alps with his wife and daughter Dorothea, and was very loath to tear himself away. However, his interest in the international movement was so strong that again, and for the last time he took part in one of these great gatherings of electricians. During 1914 he again revisited Germany to attend the small committee of five delegates under the Presidency of Dr. Budde of Berlin, who soon after retired from office. Then the outbreak of the great European War put an end to all international gatherings.

CHAPTER XI

THE GILBERT CLUB : THE LIBRARY AND LITERARY EXCURSIONS

"Gilbert shall live till loadstones cease to draw,
Or British fleets the boundless ocean awe."

So sang Dryden, commemorating the great Elizabethan doctor, who in his day had been the subject of two savage couplets from the pen of the Oxford epigrammatist, John Owen (Andœnus), and of whom it was written in the *History of the Worthies of England* (endeavoured by Thomas Fuller, D.D., London, 1662) :

"Such was his loyalty to the Queen, that, as if unwilling to survive, he dyed in the same year with her in 1603. . . .

"Mahomet's tomb at Mecha is said strangely to hang up, attracted by some invisible Loadestone ; but the Memory of this Doctor will never fall to the Ground, which his incomparable book *De Magnete* will support to Eternity."

Despite the brilliancy of the fame accorded to Dr. William Gilbert by his contemporaries, not only in England, but throughout the then civilised world, his work so great and so original, was strangely lost sight of in subsequent generations. Silvanus Thompson did his best to revive the fame of "the father of electrical science," and loved to do honour to the memory of the man who "built up a whole experimental magnetic philosophy on a truly scientific basis, in place of the vague and wild speculations which had previously been accepted," and who "in an age when the fantastic philosophies of the schoolmen still prevailed . . . calmly worked out the inductive method of reasoning from the known to the unknown, trying his arguments by the touchstone of experiment."

Undoubtedly Thompson himself was profoundly influenced by the reading of Gilbert's work. His *Elementary Lessons* from the first page onwards contained many references to Gilbert's discoveries, and the popular lecture, "The Earth a Great Magnet," which he delivered in a number of cities up and down the country in the early eighties, dealt with Gilbert's greatest discovery.

In 1882 he became possessed of a copy of that treasured rarity: *De Magnete Magneticisque Corporibus, et de Magno Magnete Tellure; Physiologia noua plurimis & argumentis, & experimentis demonstrata. Guelielmi Gilberti; Colcestrensis Medici Londinensis. Londini Excudebat Petrus Short Anno MDC.*

Ultimately he possessed five copies variously bound, one with the cross of the Inquisition burnt blackly into the edges of its leaves. The "library" copy, besides being unusually large and clean, bore on the title-page the signature "W. Barlow," suggesting that the volume was perhaps the presentation copy to Gilbert's contemporary and intimate friend, the venerable Archdeacon of Salisbury, author of *Magneticall Advertisements, London, 1616*, which work, together with his other writings, found a place in the unique collection illustrative of the history of magnetism and electricity, which Thompson gradually amassed, and in which he took increasingly eager delight as years went on.

Enthusiasm is infectious. Amongst others devoted to the study of this worthy was Thompson's friend Mr. Conrad W. Cooke, who in 1889 wrote an article in *Engineering* entitled "William Gilbert of Colchester." The author described himself as "an Honorary Secretary of the Gilbert Club." He quoted from Barlow's *Magneticall Advertisements*:

"Many of our nation, both Gentlemen and others of excellent witts and louers of these knowledges, not able to read Doctor Gilbert's booke in Latin haue bin (euer since the first publishing thereof) exceeding desirous to haue it translated into English, but hitherto no man hath done it, neither as yet goeth about any such matter, whereof one principall cause is that there are very few that understande

his booke, because they haue not load-stones of diuers formes, but especially round ones. . . .

“ A second cause may be for that there are diuers wordes of art in the whole course of this booke proper to this subject, and fitt to the explication of his figures and diagrammes which cannot be understood, but by the helpe of the Mathematicks and good traouelling in the Magneticall practice.”

Thus, though already desired in Gilbert's life-time, no translation into any modern language was made, and the book itself became very scarce, never being reprinted after 1638. Cooke's article continued :

“ We are happy to say, however, that this reproach upon our scientific patriotism will very soon be removed. . . . We are approaching the tercentenary of *De Magnete*, and, with the object of celebrating the event, a Gilbert Club has recently been formed, having for its first President Sir William Thomson.

“ In accordance with the first and principal object of the club, we are glad to state that the translation of *De Magnete* is well in hand, and will be printed and ‘ got up ’ in such a manner as to be as like the original in appearance as it can be made ; it will, in fact, be a facsimile reprint in everything, except the language in which it is reproduced.”

It was out of the interest of these two friends Cooke and Thompson that the Gilbert Club arose. They gathered together a small group of scientific men, including Mr. Latimer Clark, F.R.S., who possessed what was then the finest English collection of electrical books. Having the support of a number of influential names, including important officials of the Royal College of Surgeons, the Royal Institution, the Institution of Electrical Engineers, and The Physical Society, they were permitted to hold the Inaugural Meeting of the Club at the Society of Arts on November 28th, 1899, and henceforth the success of the publication of the translation of the *De Magnete* was assured.

They were successful in enlisting the support of several prominent citizens of Colchester, Gilbert's birth-place, one of whom, Mr. Henry Laver, F.S.A., became Treasurer to the Club.

The two enthusiasts became honorary secretaries, together with Professor Meldola, who shared also this enthusiasm of his colleague and friend; and in later years they were assisted by Mr. H. B. Wheatley, F.S.A., the Bibliographer, the possessor of many books, and a fellow-member of the "Sette of Odd Volumes."

The actual labour of translation of different sections of the book was carried out by ten different persons, on two of whom, the Rev. W. C. Howell, M.A., and Thompson, the work of revision and correction for the press mainly devolved.

The Gilbert Club was in no sense a social body; it never met as a whole; most of its activities were carried on in writing in a casual manner, as may be gathered from the following letter:

"ATHENÆUM CLUB,
"September 21st, 1891.

"MY DEAR BROTHER SILVANUS,

"I am very much obliged to you for sending me your little memoir of Sturgeon. It is very interesting, and particularly so to me.

"I am quite sure that in the Day of Judgment there will arise a perfect cloud of witnesses to give expert evidence on your behalf of good things you, in your life-time, have done for them, whether before or after they had left this world. I expect, when this combustible shall have put on incombustibility (gazing through a powerful asbestos telescope with lenses of alum), to see a great procession going forth to meet you, to present their gifts, Gilbert leading the mighty throng with his Terrorella, Reis carrying a bung covered over with the skin of a German sausage, Sturgeon with an electro-magnet, Koenig with a tuning-fork, while S. A. Varley¹ will be running up and down with a six-shooter, complaining that the range is too great to get at you.

"Two things I think will interest you; *first*, that I have Dr. Leigh's copy of Sturgeon's *Scientific Researches* (Bury, 1850) "Presented to John Leigh, Esq., in token of sincere friendship and esteem by the Author." It is an *edition de luxe* printed on thick paper, a wide margin, and very handsomely bound in russia with the inscription on the side.

¹ See Chap. XIV, page 292.

Second, that there is one slight error in your memoir, namely, that Sturgeon's Reprint of Barlow was in *facsimile*; I am writing with the little book before me, and it is rather commonly got up, and, with the exception of the letter from Gilbert to Barlow, even the spelling is modernised. . . .

"What is happening to Gilbert's book? We really ought to do something for the subscribers. It will soon be two years since our inaugural meeting, and twenty months since the last meeting, and some of the subscribers have already paid their subscriptions.

"How do matters stand? and when shall we have something to show?"

"With my very kind regards to you and Mrs. Thompson,

"Ever very sincerely yours,

"CONRAD W. COOKE."

Though the Club had not in 1916 wound up its affairs by disposing of the few remaining copies of the translation, its life virtually ceased when the volumes were distributed to the subscribers in 1900, just three centuries after the publication of the original.

The publication was anticipated by some years by the appearance in New York in 1893 of a translation by Dr. P. Fleury Mottelay. This was, however, but a small volume, and, though the work of a keen bibliographer of electrical and magnetical sciences, lacked the charm of the luxurious facsimile edition.

While editing the *De Magnete* Thompson became immensely interested in critical discussion of the texts, and in the innumerable allusions to men and things, concerning which he tracked down further information, sought out quotations from the authorities referred to by Gilbert, and published his researches in a companion volume to the translation, under the title, *Notes on the De Magnete of Dr. William Gilbert*. It was in folio, and so could be bound in with the translation, being very similarly "got up," and, like it, a limited edition privately printed.

In the course of these ten years of work at the translation Thompson's interest betrayed itself more or less publicly in various directions: first in the appearance of a small volume, *Opusculum No. XXII. of the Sette of Odd Volumes*,

Gilbert of Colchester : an Elizabethan Megnetizer, issued to the members of the Sette by their Brother Magnetizer in 1890. Then that summer, to arouse local interest, he delivered at Colchester, to The Essex Field Club, a lecture, published in 1891 as one of the articles on "Essex Worthies" in *The Essex Naturalist*, "William Gilbert, of Colchester, Founder of the Science of Electricity," illustrated with cuts and a portrait, of which more anon.

In 1899 he was to lecture at the Royal Institution. Sir Frederick Bramwell wrote :

"I am very glad that you fall in with our suggestion of giving a course of two Lectures, in the forthcoming After-Easter Session.

" 'The Myths of the Magnet,' in these days of alliteration, is, no doubt, a taking title.

"I see your difficulty as regards the Volta Centenary at Como, and I believe that at the present time I could shift your two days ; . . . but I certainly do not wish to lose the valuable services of a 'live' electrician of your standing, for the sake of a dead one, born 100 years ago. . . ."

Thompson duly lectured on *The Myths of the Magnet* ; it had taken a Gilbert to dispel such beliefs as, *e.g.*, that the magnet refuses to act in the presence of a diamond, or if touched with garlic ; or that the variation of the compass is due to imaginary lodestone-mountains like those described in the *Arabian Nights*.

Thompson spent a great deal of time hunting up traces of the pedigree and arms of the Gilbert family at the College of Arms, and searching for portraits, one of which he, at a later period, discovered and purchased from an antiquarian bookseller in London, a small full-length oil-painting on a wooden panel ; he believed it to be a genuine portrait, and found no other. He made enquiries at Oxford for the Bodleian portrait of which there existed prints which he himself used to illustrate his booklets ; but the painting itself disappeared some hundred years ago, removed on account of its dilapidated condition, and the then general indifference to its subject,

In 1903 the tercentenary of the death of Queen Elizabeth was celebrated in London. In March the Royal Geographical Society held an exhibition illustrating the progress of geographical enterprise in her reign; to this Thompson contributed a collection of "Gilbertiana." At a public gathering discourses were read by distinguished men of learning; Thompson gave a short address on "William Gilbert and Terrestrial Magnetism in the Time of Queen Elizabeth" (which was afterwards printed as a booklet), wherein he claimed that "To the names of the men who made great the age of Queen Elizabeth, who added lustre to the England over which she ruled, and made it famous in foreign discovery, in sea-craft, in literature, in poetry, and in drama, must be joined that of the man who equally added lustre in science."

Colchester celebrated the Gilbert Centenary with full civic honours. Thompson was invited to the city in September 1903, and, under the Presidency of Sir Mountstuart Grant Duff, F.R.S., G.C.S.I., attended by the Mayor and Council in state, delivered a lecture in the ancient Moot Hall, illustrating his discourse by lantern slides, and by repetitions of some of Gilbert's experiments.

The electricians of the country, as represented by the Institution of Electrical Engineers, did formal honour to the "Father" of their science on December 10th, 1903, three hundred years after his death. The Institution had raised a fund to purchase a picture painted some years earlier by Mr. A. Acland, Hunt; at the suggestion of Sir Benjamin Richardson he had depicted Dr. Gilbert in the act of showing his electrical experiments to Queen Elizabeth with Drake and Raleigh and her Court; this picture was now presented to the Mayor for the Borough of Colchester, to be placed in the Town Hall, there "to maintain and extend the fame and memory of Gilbert." The following summer the Council of the Institution paid a visit to the borough to be present at the unveiling of the picture.

Thompson was the prime mover in all these arrangements, and was most generously supported by the President for the year, Mr. R. K. Gray. From an absentee member of the

Institution of Electrical Engineers he received the following letter :

“ I should not have liked to have been left out in the cold, so please accept my thanks for having given me the opportunity to stand with others.

“ And now let me tender you my congratulations on the success of your efforts. I know it has been to you a work of great love, and that nothing will have given you greater pleasure than in thus honouring the name of one to whom the science owes so much, and who, but for yourself, would scarcely have been known.”

All that Gilbert had left in print concerning his researches was contained in a single chapter in the second book of his *De Magnete*. This, reprinted from the version prepared by the Gilbert Club, with notes added by Thompson, and a reproduction of the Colchester picture, was issued for the Institution of Electrical Engineers as a booklet, beautifully printed at the Chiswick Press, which Thompson employed for all this work.

His *Gilbert : Physician*, also privately printed the same year, was a brief history of the doctor's professional life, compiled from facts obtained by literary researches, and supplementary to the already existing, but scanty biographical notices. Thompson had searched the records of the Royal College of Physicians determined that no trace should escape his experienced eye, and in his researches had interested several members, who took pleasure in the celebrations, and appreciated the little volume.

Nowhere were these literary achievements of Thompson more appreciated than in the circle of “ Ye Sette of Odd Volumes.” Witness this letter of Dr. John Todhunter :

“ January 4th, 1904

“ DEAR BRO. SILVANUS,

“ Best wishes for the New Year and many than for your Christmas Card—very artistic in design as usual. Thanks also for your very dainty pamphlet on Gilbert of Colchester, which both Mrs. Todhunter and I have read with very great interest. You have managed to put your

materials together in a manner that rounds off the too scanty story of his life, while giving peeps of himself and his surroundings which give a pleasant fillip to the imagination of the reader to bring from the 'dark backward and abysm of time' a ghostly picture of the worthy doctor in his habit as he lived. I like his indignant support of the experimental method in science."

Everything about Gilbert interested Thompson. The Jubilee Meeting of the Essex Archæological Society, happening in the summer of 1903, was held in Colchester, and at it he read a paper on "The Family and Arms of Gilbert of Colchester," showing a surprising familiarity with wills and title-deeds, heraldry and coats of arms.

At the Oyster Feast at Colchester, about a year later, the Tercentenary was still being celebrated, the outgoing Mayor. Mr. Ernest H. Barritt, presenting to the company a souvenir pamphlet, embodying reproductions of Acland Hunt's picture, the portrait, illustrations from the *De Magnete*, and other features of interest. Thompson, who by this time must almost have become a familiar civic figure, was present as the guest of the Mayor, and shared with Sir Norman Lockyer the honour of responding to the toast, "Science."

At Oxford Thompson had stirred up a little dust in search for Gilbert's portrait. At Cambridge, Gilbert's University, there appeared to be no visible trace of him, though he had been for some months Senior Bursar at St. John's College before entering upon his foreign travels, and his studies in Italy. Before 1898 not a vestige of Gilbert's handwriting was known to exist; but, when a signature was unearthed at the Record Office, it was reproduced and sent by Thompson to various libraries where papers, bearing it, might be supposed to exist. Four such were subsequently found in the books of St. John's College, and Thompson did not delay going to Cambridge to see them. At the British Museum there was much material in which the mention of his name might possibly be found. Thompson wrote to make inquiries about the Hardwicke Papers, and was informed by Mr. F. G. Kenyon, of the British Museum, who was his correspondent in these matters, that :

"There are quantities of State and private papers here of the Elizabethan period, especially in the Cotton and Lansdowne collections; but to search through all of them, on the chance of finding William Gilbert's name, would take up more time than the results would be likely to justify. On the other hand, if one has his name in mind, one may light upon it while searching for other things. His name occurs sometimes in the index to the Domestic State Papers, published by the Record Office; but the mentions of him do not seem to be important. . . .

"We have the drawing by Camden of Queen Elizabeth's funeral procession, together with a coloured enlargement of it recently left to the Museum by Baron Ferdinand Rothschild. We have just been putting both on view in one of the show-cases, as being of special interest at the present time. Gilbert does not, however, appear in them, and, as the figures are clearly not portraits, it would not help much if he did. There is one group entitled 'clerks of parliament and doctors of medicine,' which may contain him, but the individual names are not given.

"If I should come across any mention of Gilbert I will let you know."

Thompson possessed himself of a copy of this "Procession," and used to point to one figure in the group of physicians as being remarkably like the portrait of Dr. Gilbert.

He was very frequently in the reading-room of the British Museum, comparing the library copy with his own latest acquisition, or with an entry in some catalogue of rare books, of which multitudes reached him from all quarters of the globe, as well as from Tregaskis and Quaritch of London. Mr. Bernard Quaritch was an "Odd Volume," and took personal interest in Brother Magnetizer's library.

Latimer Clark's collection of books was placed at his disposal:

May 1893.

"DEAR SILVANUS THOMPSON,

"I have looked out in my library a list of works prior to 1600, which treat of the magnet and lodestone, and I have put a tick to those which I think worth looking at. They are unfortunately *rather numerous*, but they are all in my own room, and very easily referred to, and I have

indicated on the cover the pages at which the notices are to be found, so that a glance at them would show you what there is of interest in them. It would take you an hour or two to glance at the whole of them.

"In addition to those on the list there are some others which are named in the printed pamphlet enclosed.

"I am always at your disposition, etc.

"LATIMER CLARK."

Amongst other Elizabethan collections which Thompson searched was that of the Cecils; by permission of Lord Salisbury, he was allowed access to certain papers in the Library at Hatfield House to which he had some clue, and where he thoroughly enjoyed his expedition and found some reward for his labours.

His opportunity to make more of his work known in London came to him shortly before the Tercentenary, when he was invited to give a course of two Saturday afternoon lectures at the Royal Institution. He wrote to Sir William Crookes :

"MR. Y—— writes me that you suggest as a title for my two lectures 'Science in the Days of Shakespear.' But why drag in Shakespear? I shall be expected to discourse on the Botany, Astronomy, and Alchemy of the Shakespearian plays—and that is outside my ambit. I don't object to 'Magnetism in the Days of Queen Elizabeth'; but I should give a slight preference to something such as the following :

" 'The *De Magnete* and its Author.

" '(i) The Book.

" '(ii) The Man.'

"If you would accept the former, I should be satisfied; but I rather wanted the second of the two lectures to be devoted particularly to some personal account of Dr. Gilbert. I have unearthed a good deal about him in the last two years.

"I am off to Italy to-morrow night: please reply to Hotel Bauer-au-lac, Zurich, where I shall be on Sunday. [An excursion with the I.E.E.]

"P.S.—That *Radium* should have a + temperature of $1\frac{1}{2}$ deg. centig. above surroundings is *most* inexplicable. I always expected it would have a slight minus temperature to account for energy flowing into it from the environment,

and so keep up its activity in emitting radiations. It is most marvellous—if substantiated.”

Sir William replied :

“ MY DEAR SILVANUS,

“ Certainly, we would not on any account ask you to lecture under a title to which you have the least objection. I have at once adopted your proposal, and will announce the lectures. . . .

“ I am being torn to pieces by wild newspaper men, each with a sillier question than the other. Yesterday I had a succession all day long ! Fortunately I was out most of the time. Also I am having applications from amateur chemists in the country, asking for the loan of a gramme or two of Radium.

“ I hope you will enjoy this fine weather abroad. I suppose you are staying over Easter.”

Thompson found a good many people who enjoyed being “ helpful ” in his hunts. His book-loving friends, many of whom caught something of his interest in Gilbert, wrote to him of any traces or clues they lit upon. One, a biographer of Galileo, wrote from Italy of his inquiries and researches among the Galileo relics, and the archives of Florence, Padua, and Venice for the papers of Gilbert’s friends, Fra Paolo Sarpi and Giovanni Francesco Sagredo. It was clear from the *De Magnete* that Gilbert had been very familiar with Italian science, and was himself as well known to them as his work, of which Galileo wrote in high praise. When in Italy with the Institution of Electrical Engineers, Thompson found time to explore the MSS. of the Ambrosiana at Milan, and on his way home saw the Perigrinus at Paris in the Bibliothèque Nationale, and when, in 1912, he found himself again in Florence, he spent a good deal of time in the Medici library pursuing the early history of magnetism.

In Germany Gilbert had found an admirer in Gustav Hellmann, whose bibliographical notes were published in America ; with him Thompson kept in touch in this interest for over twenty years, the Hand List of his Library sent to Berlin in July 1914 being the last link in their friendship. .

Across the Atlantic there were other enthusiasts with whom Thompson kept up an intermittent exchange of news. Prominent among these were Brother Potamian (M. F. O'Reilly) of Manhattan College, who prepared the bibliographical catalogue of The Latimer Clark collection, presented to the American Institute of Electrical Engineers as "The Wheeler Collection"; also Mr. W. D. Weaver, connected with the same library, who wrote to ask Thompson's aid in the compilation of the catalogue, as he considered "that no one else in this world has an equally extensive or exact knowledge of the subject"; and Dr. P. F. Mottelay, translator of the *De Magnete*. Already in May 1903 the last-named wrote to Thompson:

"Goodness me—still at Gilbert! I thought he had been thoroughly done for. You certainly are a delver, and should, indeed, be well rewarded. I can appreciate what it is to go through such MSS."

The following are three particular instances of varied interest, illustrating the manner of Thompson's "delving."

In 1902 he was hotly pursuing Gilbert's signature. When passing to or from the British Museum Library he used to drop in at the workshop of Mr. Douglas Cockerell, the bookbinder, in a turning off Museum Street. There he would handle some of the interesting old books that came to the master-hand for repair, and there he took several of his own treasures for treatment or binding. Mr. Cockerell wrote to him one day of having bought, for the sake of its binding, an old copy of Aristotle's *Stageritæ de Naturali Auscultatione, etc.*, dated 1542, with the name of William Gilbert amongst others on the title-page, and with many marginal notes. Thompson's enthusiasm was aroused. The book was sent to him, and he took it to Cambridge, and established from the records of St. John's College the authenticity of the signature beyond any doubt. He was also able to identify the names noted at the end in Gilbert's handwriting as being those of students at the college at the time of his Bursarship. Some of the marginal notes were

in his hand, others in that of (Archdeacon) Thomas Drant, whose autograph was on the same page with Gilbert's. It was with great delight that he established the identity of the book as Gilbert's own Aristotle, and with equally great joy that he became a little later its proud possessor.

An earlier excursion had taken him within the portals of the Bibliographical Society, where he read a paper on "The Printers at the Sign of the Brazen Serpent, more especially Peter Short," and stated his quest thus :

"Upon the title-page of the *De Magnete* there stands a device of a serpent entwined around a T-shaped support, which is held upright by two clasped hands emerging from rounded masses of cloud. The design is executed in a rather coarse woodcut. It is not accompanied by any explanation. . . .

"What had this serpent to do with Gilbert's *De Magnete* ? So far as I was aware none of the myths of the magnet were connected with the serpent. It could not be part of Gilbert's armorial bearings : for these were known. . . . Could it have anything to do with Gilbert's office as President of the Royal College of Physicians ? The caduceus, so often used as the emblem of medicine, required two serpents entwined around a wand ; but here was one serpent coiled upon a tau. Lastly, could it be a printer's Mark ? "

He found the solution eventually in the British Museum. He described his researches to Mr. T. Bailey Saunders, then studying Melanchthon, in a letter which led to the following correspondence :

" March 14th, 1907.

" DEAR BAILEY SAUNDERS,

" Your remark that Erasmus adopted as his arms the Brazen Serpent, explained to me a thing that I noted as a mystery ten years back, and which has remained so till now.

" Ten years ago I went *serpent-hunting*, i.e., I tried to find the significance of the serpent on the tau which is imprinted on the title-page of Gilbert's *De Magnete*. I found the immediate solution beyond all doubt that it was the mark of the printer, Peter Short. The Bibliographical Society published my research, of which I send you a copy. But incidentally I found a mystery (see p. 10), that one Vincen-

tius Valgrisi in Venice, and his successor Felici Valgrisi, who used a serpent mark, described their books as being printed, or issued, *dal segno d' Erasmo*. I never could fathom this collection, which was unintelligible. Could you refer me to your authority—not that I doubt it, for it is abundantly clear—for the fact that Erasmus adopted this device for his Waffen ? I want to know *the year*, and, if possible, his reasons for this choice.

“ Believe me,

“ Yours most sincerely,

“ SILVS. P. THOMPSON.”

“ EASTBOURNE,

“ April 5th, 1907.

DEAR SILVANUS THOMPSON,

“ I propose to come to town on Monday next for one night to search once more in the B.M. reading-room before the bees and drones there are expelled from that hive at the end of the week, and compelled to supplicate for desks in other parts of the building. Among other things I want to settle the question which you have vexed and ventilated, of the serpent on the tau ; I want to get out all the first editions I can of Melanchthon and Erasmus, and see whether the theory is correct that it is only a printer's mark, and not the heraldic device of either of them. Could you spare an hour or two in this holiday season, on Monday afternoon, to share in the search ? Your experience and interest in the subject would, I confess, be of much advantage to me ; and perhaps I might be fortunate enough to hear you pay the same compliment to me !

“ I observe by a letter in *The Times* some days ago that you are again being put up for election by Convocation to the Senate. I sincerely hope that you have been already elected, or will soon be so. . . .

“ Yours ever sincerely,

“ T. BAILEY SAUNDERS.”

A day or two later it was announced that at an election at the Athenæum Club, under Rule 2, by which every year a few persons distinguished in Art, Literature, Science, or Public Service are specially elected members, Silvanus P. Thompson was one of the three to secure that greatly prized honour.

" April 10th, 1907.

"DEAR BAILEY SAUNDERS,"

"The brazen S—p—T, that is for the moment my *alter ego*, and not 'il segno d'Erasmus'—feels quite three digits added to his stature at the congratulations that have been pouring in upon him. Amongst them, yours, *buon amico mio*. I hope not long hence to fraternise with you again, not at the sign of Erasmus, but at the sign of the Owl—*non invita Minerva*, that is to say. [The head of Minerva is the crest of the Athenæum Club.]

"Now you ask me what is my 'final conclusion' as to the meaning of the phrase *dal segno d'Erasmus*. Well, really, my final conclusion is still far distant. Far distant, because (by reason of my Royal Institution lecture next Saturday) I can't go again to the B.M. this week; and, as the Reading-room will be closed for six months, and as it will take me perhaps a fortnight to hunt up all the books printed by Valgrisius, I may be able perhaps by October 26 to draw a judgment, possibly a final one. At present my firm conviction is that *il segno d'Erasmus* was the designation of the officina of Vincentius Valgrisius: *why* so I don't know; and whether it was symbolised by a brazen serpent hanging on a tau I don't know.

"I suddenly remembered an hour ago that I possess—an heirloom from my grandfather—a copy of Erasmus' *Encomium Moriae*, with the etched illustrations of Holbein. I looked it out, for as some of the cuts are unrepresentable *virginibus puellisque* I keep it in a locked cupboard. It is 'ΜΟΡΙΑΣ ΕΓΚΛΜΙΟΝ. Stultiticiæ Laus. Des. Erasmi Rot. Declamatio. Figuris Holbinianis adornata. Basilie MDCLXXVI.' Pretty late! A copper-plate title-page, followed by an ordinary printed one. Then comes a dedication-page to Colbert with an engraved head-piece in the middle of which is emblazoned a serpent; thus: [sketch].

"He is not suspended on a tau. Whether these are the arms of Colbert I know not. It is not a printer's mark, for the book is imprinted 'Typis Genathianis,' and the printed title-page has an astronomical device (as a mark) of an eclipse, with the words: 'Patitur nec dissolvitur.' Fancy the moon being down on her luck, and suffering yet resolute!

"I have a note that in Bagford's Collection of title-pages in the B. M. there is an exquisite engraved figure of Erasmus (in copper-plate) as title to the *Colloquie* in an Amsterdam edition printed by Guili. Janson (MDCXXI ?)—in Bagford's

volume ix, p. 23, no. 142. You should see it. But it throws no light on the great serpent problem, which remaineth still 'wrop in mistry.'

"Ever truly yours :"

[Signed by a serpent twining to make S. P. upon a T].

These letters serve to show the thoroughness with which detail was pursued, and with what delight. To the reprint of the paper on "Peter Short" by the Bibliographical Society, Thompson appended his apologia in a footnote :

"This paper is of the nature of a literary incursion. One who, whatever his experience in navigating other regions, has without compass or pilot, without sailing orders, with no charts save the Catalogue of the British Museum, ventured forth into the archipelago of Elizabethan literature must indeed be rash. If he does not meet with deserved shipwreck, he must at least apologise for his unwarranted adventure."

The *De Magne*te aroused Thompson's interest in gems. Besides the "electric" amber and "magnetic" loadstone there were others of which Gilbert wrote, and many others which he knew to be prized by the ancients for their virtues. For further enlightenment in this particular field, Thompson turned to the orientalist. He had some correspondence with an old member of the Society of Telegraph Engineers resident at Teheran, there engaged upon the works of three Persian lapidaries, and delighted to send notes of scientific interest concerning certain stones.

On another occasion he applied to Dr. Murray of the *Oxford Dictionary*, and received by return post a reply written on the back sheet of this note :

"DEAR DR. MURRAY,

"Can you tell me whether the word *vincentina* occurs in English as the name of a mineral ? It is used in Latin, by Dr. Gilbert, as a synonym for 'gemma Vencentii rupis'—the Bristol diamond so called—found near St. Vincent's rocks at Clifton.

"Believe me,

"Yours very truly,

"SILVANUS P. THOMPSON."

"DEAR PROFESSOR,

"We have no trace of the term *Vincentina* in English, though, not having yet reached V, it is not possible to say what may or may not turn up in the meantime. But the term is not in Chester's *Dictionary of Names of Minerals*, the latest and fullest known to me, nor among the synonyms in Dana's Index. The latter would indeed condemn the word at once as irregularly formed, since he ejects all names in *-ine* as fancy names, not scientific. All mineral species are named in *-ite*. But a *variety*, merely popularly recognised, like *serpentine*, might retain *-ine*, and in this respect 'vincentine,' if it had any distinctive meaning, might be allowed. The man who knows best about mineral names is L. F——. Ask him.

"Yours very truly,

"J. A. H. MURRAY."

Thompson's library contained a number of books on the subject of gems; amongst the earliest of its printed treasures was an anonymous work, *Lapidarium omni voluptate refertum*, printed in Vienna about 1506 by Winterburger, the owner of one of the earliest presses in Vienna, whose books are much sought after. Of later date there were Robert Boyle's *Essay about the origine and virtues of Gems*; von Frankenberg's *Magnetisches Edelstein*, a very rare book unknown in several of the best collections; and van Helmont's *Ortus medicinae*, published in Amsterdam in 1648, and particularly cherished by its owner for its accounts of the Magnetic Cure of Wounds, and the Magic of Amber.

Thompson wrote and read several lively essays on such subjects as *The Virtues of Gemmes* and *Flies in Amber* at the "Odd Volumes" and the "Portfolio Society," where the literary rather than the scientific outlook was predominant.

A reference in the *De Magnete* to the letter of Peter the Pilgrim set Thompson upon yet another quest. In the first of his "Tyndall Lectures" at the Royal Institution in 1907 he gave to the public the results of his labours on the works of Petrus Peregrinus, or Pierre de Maricourt of Picardy, a wandering soldier of fortune of the thirteenth century. In spite of his profession he was a student of magnetism, possess-

ing, for that early date, remarkable scientific method, as set forth in his manuscript *Epistola de Magnete* in 1269.

Only twenty-eight copies of his manuscript are known to exist. Thompson was familiar with the one in the British Museum, which was interesting for the annotations and explanatory diagrams by the hand of the astrologer Dr. John Dee (the subject of yet another of Thompson's biographical essays), who told how the sailors in the North Sea used to keep their lodestone locked up as long as known land was in sight, and took it out to touch the compass needle when on the open sea.

The Thompson Library copy of the MS. was an Italian one of the fourteenth century, and had been in the Library of Prince Boncompagni, and used as the basis of the printed version by Padre Bertelli in the sixteenth century. This printed work is even rarer than the MS. Thompson's copy came from the library of the same Prince, and was the only copy not in public collections. He had another imperfect English MS., which was reproduced in facsimile by Quaritch, printed in black with the red and blue capitals of the original, a style adopted by Thompson in the printing of his translation, except that the coloured lettering was all to be done by hand. Thompson himself rubricated a number of copies in leisure minutes during winter evenings, and when away on short winter holidays at Bath or Torquay. The little volume was privately issued by the translator.

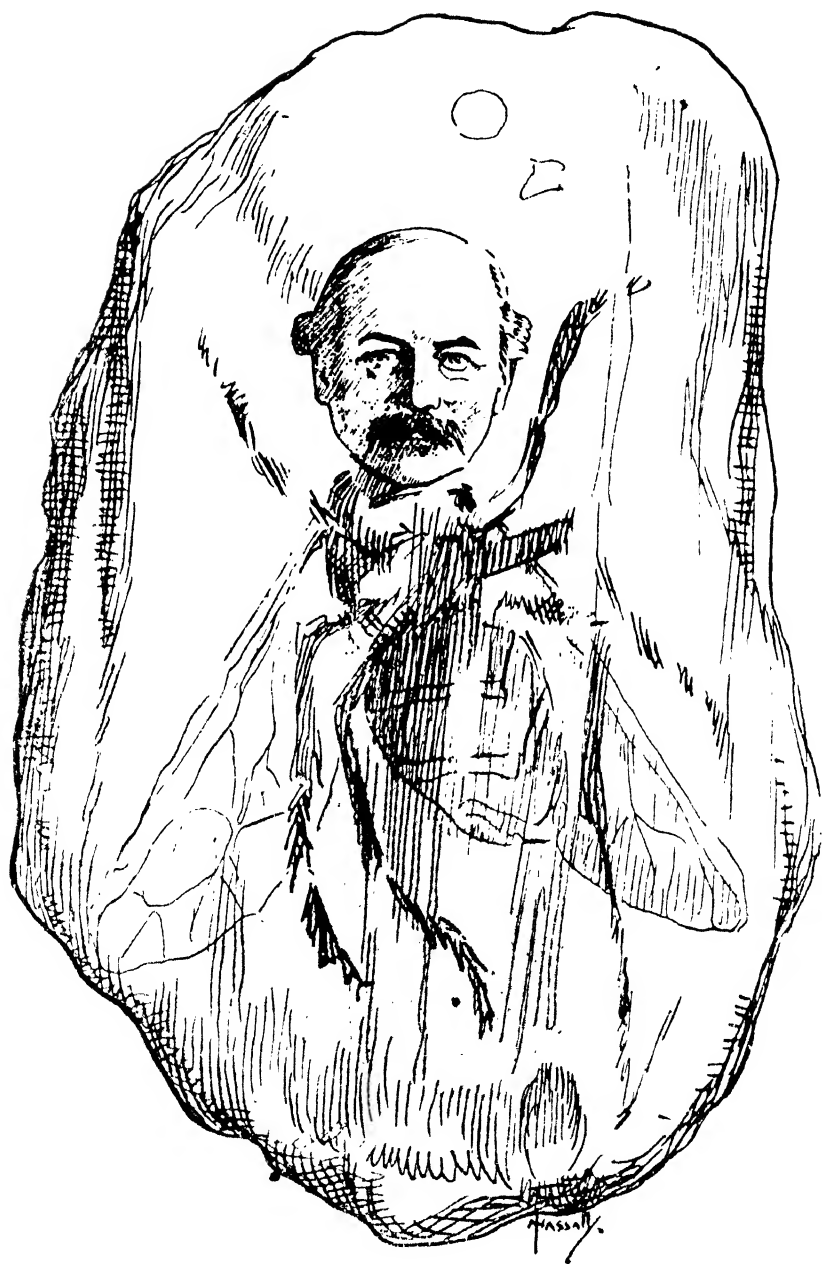
The British Academy published a memoir on P. Pergrinus from a paper Thompson read before that body in 1907, of which the following letter from Sir William Huggins, the astronomer, President of the Royal Society, is an appreciation.

"MY DEAR PROF. THOMPSON,

"Many thanks, indeed, for the welcome gift of a copy of your British Academy paper on Peter P.

"One is at a loss whether more to admire the wideness of your scientific, literary, and artistic interests and powers, or your ability of microscopic concentration in the unravelling of the obscure and the involved. Of all this your

Ye Sette of Odd Volumes.



Brother Silvanus P. Thompson, F.R.S., on
"flies in Amber."

paper is a notable illustration; which, besides on its own account, is of great interest."

Thompson followed up the history of the compass from the days of Peter P., and in 1913, on the occasion of the International Congress of Historical Studies held in London, when he represented the Royal Society on the Executive Committee called by the British Academy for making the necessary preparations, he read at one of the sectional meetings of the Congress a paper on "The Origin and Development of the Compass Card" (*Rosa Ventorum*). He had then been working some ten years at the subject, and had amassed a collection of compass-cards dating from 1640 onwards; as the earliest in existence date from 1584 his collection was pretty thoroughly representative. When giving the Odd Volumes an evening on the subject in 1907 he wrote to Conrad Cooke:

"I am hoping to greet you to-morrow night at the Dinner, and write to ask whether of your goodness of heart you would kindly bring round with you your Chinese Compass, which it's a beauty and didn't owe to be kept for ever in the dusk and Cimmerian darkness of your study. I have lots of compass-cards—but never a Heathen Chinees.

"Ever fraternally,

"YE MAGNETIZER."

"TO THE MOST NOBLE,
AND RIGHT REVD.
YE MECHANICK."

In his library he collected a number of old treatises on navigation by the compass, and a specimen of those rare old sailing maps with decorative wind-roses. Amongst his treasures in this category was a work of Blondus, *De Ventis et Navigatione Libellus*, printed in Venice in 1546, an excessively rare book, containing directions for sailing out into the open ocean to the New World. The wind-rose depicted had only twenty-six points instead of the thirty-two of the ordinary mariner's compass, and was unique. Another, Mark Ridley's own copy with marginal notes and corrections of his *Short Treatise of Magneticall Bodies and Motions* published in 1613, contained an early map of

Australia ; and a third variety, Maister Thomas Blundevile *His Exercises . . . in the Arte of Navigation* had a Wind-rose and told of the legends of Flavio Gioia and the Lode-stone Rock. A companion volume on *The Theoriques of Seuen Planets* published in 1602, contained as addendum an account of Gilbert's work, which was annotated in handwriting, possibly that of the learned doctor himself.

Thompson's collection of books was of particular interest to only a limited circle, but its fame became known in America, where old books are rarer than in England. Dr. Mottelay came to England in 1909, and visited Thompson at "Morland" in order to see the books. He wrote :

"I have not yet quite recovered from my agreeable surprise at your very extensive collection of early magnetical and electrical literature. I arrogate to myself properly, the right to say that I know as much as 'the next man' does—Dr. O'Reilly not excepted—about the Latimer Clark collection, which I have handled again and again, and I will maintain, and can very easily prove, that yours surpasses the latter *far more* than the Clark does the Ronalds [collection in the possession of the English Institution of Electrical Engineers] in many particulars. You not only have practically what they have, but you can claim, what the others cannot, that your collection embraces several examples of many different varieties and numerous singularly attractive bindings, the like of *not one* of which latter can be found in Latimer Clark's.

"You are certainly to be envied, and I heartily congratulate you. I think so much of your collection that I shall unselfishly add to it wherever I can. . . . When I am on the Continent I will remember that you want more particularly an Affaydatus . . . but not another 1628 Gilbert !"

Dr. Mottelay afterwards became more familiar with Thompson's library, and rendered him very considerable service, especially in the preparation of his Hand List, printed in 1914, when he had decided that he would part with the collection of upwards of 900 old and scarce books of earlier date than 1825, should he find some institution of learning

or science desirous to possess it. It seemed most likely that this would be across the Atlantic.

After his death a movement was set on foot by his friends among the Electrical Engineers to purchase his books for the Institution, and when this was carried through the collection became known as the Silvanus P. Thompson Memorial Library, and should be fitly housed in the Institution Buildings on the Thames Embankment.

At "Morland" the books were not arranged in a fashion adequate to their worth. The library, built for a billiard-room, was in the basement at the back of the house, with a large bow window opening to a flight of stone steps out of the area up to the garden, green in summer with its screen of trees and creeper-covered gables. Inside, the whole of the walls from floor to ceiling was lined with books and papers. The 8,000 pamphlets were in lockers round the walls, above books and below books. The woodwork was only black enamelled deal, but in the panel of each of the locker doors Thompson had pasted a richly coloured Japanese design, which lent a certain distinctive air to the shelves. Most of the old books were at one end of the room, and their bindings attracted the eye at once. Over the fireplace was a large painting of a double rainbow. The tables, benches, cabinets, window-ledges, and even much of the floor-space were piled with scientific periodicals and catalogues, accumulations of correspondence, portfolios into which were sorted matter relating to some chapters of a book under construction or revision, or some patent case seeking his support in the law courts, or the calculations of some practical work done at the College. His private secretaries used to work there intermittently. The room was never desecrated by the *housemaid's* duster, and was generally referred to as "chaos" by the irreverent younger generation, who did not fathom its method; it was distinctly a place in which the master must not be disturbed, except for some very grave reason, or to receive the good-night salutation if he happened to be there at bed-time.

The smaller "study" upstairs, leading out of the drawing-room held a good many of the most choice books of the

collection, as well as shelves full of theological and philosophical works.

Thompson's books were his friends ; he knew such an extraordinary number in an almost personal way, and his pencil left comments and notes on fly-leaf and margin. His book-plate was of his own design, with the family coat of arms as its main feature. Many of the books were treasured for more than the interest of the contents, some being associated with his particular heroes of science. For example : there was Sturgeon's *Course of Twelve Lectures on Galvanism*, with an autographic dedication by the author, the only piece of Sturgeon's writing Thompson ever found ; these books had belonged to Faraday, with his book ticket in them, one his own autograph copy of his *Experimental Researches* ; his *De Viribus Electricitatis* of Galvani was Volta's copy with "ex dono auctoris" on the title-page in his handwriting. Then there were Descartes' copy of Galileo's *Dialogus de Systemate Mundi* with the signature "Cartesius," and marginal notes in his handwriting ; and two books of Ampère's bearing his inscription. One book had belonged to S. T. Coleridge, another bore the bookplate of the Penn family of Pennsylvania, a first edition this, of Franklin's *Experiments and Observations on Electricity* ; and yet another was specially chosen out for the sake of its printer's mark, the Aldine Anchor in one of its rarest forms.

There were other books in these lockers ; some choice work of William Morris, printed at the Caxton Press in a style Thompson greatly admired and imitated in his booklets ; portfolios of trial sheets ; books on printing and bookbinding and the care of books. Another little collection of books, on the Legend of the Pied Piper of Hamelin, and other rat episodes, included his own *Opusculum* ; for this was the subject of yet another paper to the Sette, being an account of his own researches as to the origin of the Piper tale. He loved mysteries, among others that of Edwin Drood, speculative literature concerning which was represented on his shelves.

His Piper volume has a frontispiece picture of the Pied

Piper by John Hassall, the "Limner" of the Sette, and has also this prefatory page.

"An Odd Volume of a Set of Books bears not the value of the proportion to the perfect set."—BENJAMIN FRANKLIN.

"DE TE FABULA NARRATUR

"DE TE—*of thee thyself*, magnetic Brother
(And well the Sette wots it can be no other),
FABULA—the *Story*—here retold anew—
NARRATUR—*runs*, though now no tale, but true."

[Added after the reading of the paper printed as *Opusculum LIII.*]

"TO HIS ODDSHIP, THE MAGNETIZER

"Nay, nay, dear Oddship, theory won't avail—
For 'neath thy sway our senses have grown riper;
And now we know the meaning of the Tale:
We play the Children's part, and *thou*'rt the Piper.

E. S."

This illustrates the manner in which the Sette was accustomed to embellish the menu and programme of the evening's entertainment, with caricatures, and apt quotations or original rhymes. One form of versification in particular was much affected for some years, of which the above is an example. These "Quatrains" were collected for distribution to the Sette in 1904 (the year of Thompson's Oddship—Presidency).

When he was elected President, Thompson had been a member of the Sette some fourteen or fifteen years, during which he had not only supported many of his predecessors with papers and discourses, but thoroughly enjoyed those of others and played his part in the discussions and speech-making, and the thrust and parry of wit in the good company of the "odd" persons.

"Odd, that is to say, in the sense of being each unlike the other, unlike in craft, thoroughly individual in our unlikeness, each unmatched—or matchless, if you prefer it so—yet all united in a common possession of literary tastes. Each of us is fond, but each in his own way, of books; and has his own special bookinesses. Some of us love books for what we find in them for intellectual food or spiritual companion-

ship ; some for good paper and fine printing ; some for the beauty of their illustrations ; some for the splendour of their binding ; some for literary or personal associations with them or their authors ; some for the book-plates to be found in them attesting their pedigrees."

The Presidency was to Thompson quite a serious affair, as may be gathered from his address to the Brethren, whom he described in the above quotation.

" Once a month we meet as a united Sette upon the shelves of our library, to find our respective individualities all the more appreciated, because, the more individual we become, the more perfectly do we each fill his own niche upon the shelf. Our sette is a little microcosm which the more truly, represents the great world without, the more diverse, that is the more odd, we its constituent items may be. We are all, as living individuals, filled with individual aims and ambitions, we have objects in life, literary or artistic aspirations, hobbies, and tastes ; we all have axes to grind and logs to roll. And in the midst of a wicked and ungrateful world, where literature quarrels with science, where science despises art, where art mocks at learning, where learning spurns amusement, and amusement tends more and more to flout art, literature, and science, there is much need for such a microcosm which the world might well regard as the image of what it should itself be. For in the perfect Sette we reverse all this. To heighten and exalt literature, it must be associated with art. To ennoble art, it must be inspired by poetry or nature-study or antique lore. To honour science, it must be given a literary setting. To music, to history, to poetry, to painting, to travel, to the drama, to the majesty of jurisprudence and to the constructive arts, the perfect Sette accords its welcome. They all contribute toward the rounded conception, the harmonious whole. Rightly then, coming once a month to eat at our common table, we mix Mutual Admiration with our Conviviality (using the word in its nobler sense of knowing how to live together), and enjoy them both the more in that we share them both with those guests who honour us with their company, and learn the inner meaning of our mutual bond."

The catholicity of Thompson's friendships might be gathered from the guests he brought to the meetings ;

besides his family on Ladies' Nights, and many of his scientific colleagues, he introduced on different occasions such distinguished guests as Lord Alverstone, Lord Bryce, Sir Francis Carruthers Gould; and the late American Ambassador, Dr. Page, accepted his invitation to one of the ordinary meetings.

But Thompson considered that "it is not our habit of hospitality, not our practice of conviviality, not our breezy atmosphere of mutual admiration that will secure immortality. By our permanent contributions to the literature of England we shall stand or fall." He was not satisfied that their efforts should end in the publication somewhat irregularly of "Year Bokes that chronicle in delightful literary form" the proceedings of the evening gatherings, and occasional Opuscula, though many of these were literary jewels.

"The very smallness of the jewel is its glory. But the jewel must be genuine, clear, rightly cut, brightly polished, well set." "True philosophy neglects not the small for the great." "The less ambitious in letters is often the more successful. For my own part, I prefer Wordsworth's 'Sonnet on Westminster Bridge' to his 'Excursion,' Keats's 'Ode to the Nightingale' to his 'Lamia' or 'Isabella'; Tennyson's 'Tears, Idle Tears' to the 'Idylls of the King'; Browning's 'Pied Piper' to his 'Sordello.' . . . I may be wrong, but I prefer the sonnet called 'Renouncement' of Mrs. Meynell to the whole of William Morris's poems: I had rather have written Matthew Arnold's 'Scholar Gypsy' or his 'Thyrsis' than Byron's 'Childe Harold.'"

He reminded them that the early members of the Sette had hoped to produce from time to time some greater opus to place alongside the little volumes, the Opuscula, valuable as some of these were. "Behind the burlesque ceremonial of the Sette are hidden the sterner realities of its literary being: we have learned with Horace to mix a little folly with our wisdom; to play the fool gently, with grace, with art, withal not forgetting that there is a place for tears as well as for laughter in all things human."

At the end of his Oddship, Thompson received congratulations from a number of the Brothers on "a brilliant year." Perhaps his ready tongue was of assistance to him in this position. Sir William Crookes, accepting an invitation to his Ladies' Night, wrote :

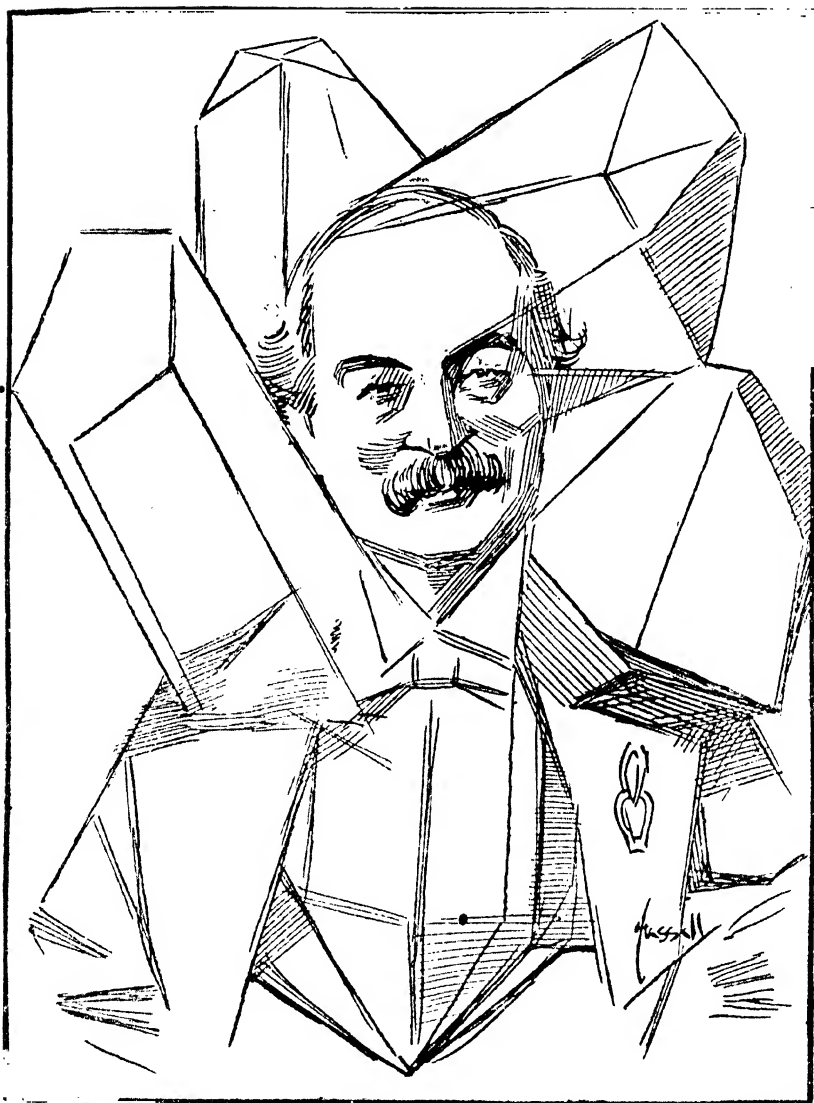
"The thought of having to rise on my hind legs altogether upsets the pleasure of a dinner with congenial friends. You, to whom speaking comes as easily as breathing, cannot understand the trouble it is to us on a lower linguistic plane."

His genius was certainly not unappreciated in the Sette. An absent Brother, the Apothecary, wrote later :

"I have just read thro' your Year Book with very great interest and pleasure. It seems to take me back to the good old times when there was such a real feeling of union and brotherly love between us all."

There are several cartoons of "The Magnetiser" drawn by Jack Hassall; the latest adorned the programme the night Thompson spoke on "Crystals of Snow and Others," and is labelled "a Many-sided Crystal. Very rare. The property of Ye Sette of Odd Volumes. Not a Cubist Portrait."

This final appreciation is from the pen of Dr. John Todhunter, "the Playwright," perhaps the most gifted literary man of the Sette, and to Thompson, one of the most congenial in spirit. It was written quite near the end of his life, when he had been long absent from the fraternity, and appreciated Thompson's faithfulness. He had just received a copy of the paper on "The Wind-rose." "You are," he wrote, "one of the few members of the Sette who knows and can explain everything, and is as much at home in Art as in Science. You are a Brother of whom it may truly be said: '*Nihil tetigit quod non ornavit.*' Floreat semper Frater Silvanus!"



A Many Sided Crystal. Very rare. The property of Ye Sette of Odd Volumes. NOT a Cubist Portrait.

Brother Magnetizer.

CHAPTER XII

WORK ON OPTICS AND ILLUMINATION

“If no optical invention of first magnitude, no discovery of fundamental importance has been announced, it must not be assumed that there have been no advances. Progress there has been, progress solid and real, if inconspicuous, all along the line. No branch of physical science can in the present day remain stationary. The workers are too numerous, the rewards of success, whether in the joy of scientific discovery, or in fame, or wealth, are too tempting. Moreover, the increase of knowledge, the mastery of principles over phenomena, the conquest of the forces of Nature, are cumulative. Every attempt at wider generalisations, even if unsuccessful in itself, provokes new researches and extends the foundations for further advance. To this truth the science of optics forms no exception. Progress is continuous, even though the work-a-day world hears little of it, and heeds it not. For the true pioneer halts not to listen for the sound of the plaudits: he toils on content in the faith that some day he, or those after him for whom his labours will avail, will arrive at the goal.”¹

Earlier chapters contain references² to Thompson's activities in optics at the beginning of his career. Of the seven papers published during 1877 five were on optical subjects: certain properties of the eye, optical illusions, and polarising prisms. Though this proportion of his work was not again devoted to optics until late in his life, he did not ever entirely drop his activity or his investigations in this field. The design of new polarising prisms³ continued to be his favourite optical exercise, and in 1883 he gave to his friends R. and J. Beck, the Quaker firm of manufacturers of optical and other scientific instruments, the process which he was working out, that they might try making some prisms for a mineralogical microscope. His

¹ Presidential Address to the Second Optical Convention, 1912.

² See pages 44, 46.

³ See page 61.

work was published in the *Journal of the Royal Microscopical Society*, when he read a paper to that body on polarising apparatus for the microscope.

Thompson acquired a very large collection of objects for displaying by polarised light, both for the microscope and the lantern, objects which in themselves are quite colourless and dull, mere bits of spar, variously arranged, yet in the rays of polarised light transmitting brilliant combinations of colour, which can be completely changed by the mere turning of one of the prisms through a small angle. To find the mathematical explanation of these colours took a genius such as Newton's, but Thompson used to offer to the public some attempt at an explanation in a popular lecture, "The Colours of Polarised Light." This was his subject when, at the time of the meeting of the British Association in Newcastle, 1889, he delivered a lecture in the large Tyne Hall, under the auspices of the Sunday Lecture Society.

For the making of some of his prisms Thompson sent as early as 1881 to Germany, and had some correspondence with a firm of instrument-makers in Homburg. In 1884 he was informed that calcspar polarisers "*nach* Thompson" were being made in Berlin. His work on the subject was known over there, probably more widely than in England. He showed himself very familiar with the work of the Germans, referring in his papers to the formulæ of Dr. Abbe and to the new kinds of optical glass of Dr. Schott of Jena. A new instrument which he devised, a direct-vision spectro-scope which also polarised the light, was the outcome of a remark on the part of Mr. Ahrens, the Londoner, who did the actual cutting, grinding, and setting up of a number of his prisms.

None of this polarisation work was communicated to the Royal Society; several papers were read at the Physical Society, and published in the *Philosophical Magazine*. It was the subject of the only Friday Evening Discourse at the Royal Institution which he ever devoted to optics, his first Discourse, in 1899, on Optical Torque (see page 158).

That year he read to the Physical Society a paper called "Notes on Geometrical Optics. Part I." (no other part ever followed) which he introduced with the following explanation :

"The division of optics into a 'geometrical' part, founded upon the treatment of the subject from the ray point of view, and a 'physical' part, founded upon the treatment of the subject from the wave point of view, has long seemed illogical. Experience in the teaching of the science suggests that it would be preferable to adopt the wave theory as a common basis, provided the formulæ of lenses and mirrors which form the staple of geometrical optics are as readily established on wave principles as on ray principles. Five years ago the author of these notes made an attempt to rewrite the elementary part of geometrical optics on wave principles ; and, though hitherto he has published nothing on the subject, he has subjected the method to the test of experience, and has made it the basis of his optical lectures year by year. . . .

As all teachers of the subject know, the very first assumptions made in establishing the elementary formulæ of spherical mirrors and lenses are that angles may be written instead of their sines, and tangents. The assumptions made in the method now published are, it is true, different, but involve no greater sacrifice of accuracy. . . ."

Thompson never found time to write the perfect book on optics which he conceived and outlined to the extent of chapter headings and a preface. But his method of attacking geometrical optics was set forth in the appendix to the volume of *Light Visible and Invisible*, in which he expounded those parts of the subject that are necessary to a serious student, but not suitable for the Christmas Lectures (see p. 192).

He was engaged in some refraction work in early years, no doubt undertaking it out of sympathy with the work of Dr. J. H. Gladstone who wrote to him in November 1890 :

"At last I have got your Refractometer released from its

incarceration at Burlington House, and return it with many thanks.

If you should happen to come across your observations on Toluene, will you kindly let me have them, and they shall be added to the long table of refractive indices which is rapidly growing."

About this time he was actively interested in the measurement of lenses, devising a method for the determination of optical constants for lens combinations of short focal lengths. He called the instrument he used a "New Focometer." To have it properly constructed was a costly business, so he applied, with success, to the Royal Society for a Government grant, to help to cover the cost, and subsequently sent a communication through Prof. Carey Foster to the Royal Society, his only paper on optics presented there. He also lectured in the winter of 1891-2 at the Society of Arts on "The Measurement of Lenses." His method evoked considerable interest amongst the more highly trained opticians, but the apparatus was not repeated, and the only model is now the property of the Northampton Institute, Clerkenwell, where optics has been, since 1898, the subject of special study.

During the succeeding ten years very little work was published. There was one paper to the Physical Society on photometers, showing him to be as up-to-date in this branch of the subject as in others, and referring to another little invention. His thanks in this case were due to his friend Mr. A. P. Trotter, who began a long letter dated April 1893: "You may like to hear the very latest thing (1) in photometers, and (2) in photometry," and proceeded to impart it with generous detail which became absorbed into the "Notes on Photometry."

That year he published also an "Opusculum" on *The Magick Mirrour of Japan*. He had become interested in these mirrors when Professor Ayrton, lecturing at Bristol, displayed the peculiar property of the polished metal mirror of casting a shadowy image of the pattern on its back in the patch of light obtained by reflecting a brilliant beam from its silvery, and apparently perfectly smooth, front surface.

It was just the kind of scientific mystery to set Thompson off in happy quest of the explanation.

This first little optical book was soon followed by the *Light Visible and Invisible*, and in 1900 by a translation from the German of Otto Lummer's *Contributions to Photographic Optics*, which gave the first account in English of the remarkable work of Professor von Seidel, of Munich; but the many elaborations and the copious additions made by the translator, with the author's full consent, rendered the book almost more a work of Thompson himself than of Professor Lummer. He was led to undertake this work by an acute sense of the lack of optical literature for technical students who were not masters of the German language; the existing English text-books were nearly all written "by university dons for university students." In his preparation of this book, as in the compilation of his *Optical Tables*, Thompson drew upon the advice and experience of the highly skilled experts of the various English firms, hoping to make his work as one "by an optician for opticians."

In the spring of 1900 Thompson took a week's holiday alone in the Thüringen-wald, with a view to visiting the famous Jena works. The following are extracts from his letters home. He travelled by Flushing straight through to Weimar, whence he wrote:

"April 14th, 1900.

"The line as far as near Cassel is uninteresting: but from Cassel onwards it is quite delightful in scenery. It was dark when we reached Eisenach, the beginning of the Thüringen-wald.

"Weimar lies outside the forest. After breakfast I wandered round the old town, which is very quaint. I visited the house where Goethe lived; and which is preserved, just as he left it. His collections of antiquities, drawings, portraits, medals, skulls (for his study in comparative anatomy) and herbarium are in excellent order. He had also a lot of optical and electrical apparatus. His Arbeit-zimmer, and the room in which he died are just as he left them.

"I had also a long walk in the park, and saw the house and garden where he sometimes lived in the summer."
[Goethe was a subject of Thompson's enthusiasm.]

" JENA,

" April 15th, 1900.

" This morning brought a heavy storm—rain and wind, and made me change my plans. I had thought to go off early by train to Ilmenau [the chief centre of Thuringian glass work]. . . . Perhaps I shall go to-morrow.

" I wrote you just after midday dinner that I was going to call on Professor Abbe. Do you remember him from Frankfort days ? He is a tall, spare, dark man, who dresses rather clerically in a long coat, and a vest that buttons tight under the chin. As he was in 1891, so he is to-day, only a shade grayer. I found him at home, surrounded by a circle of his family . . . and various friends, Professor Auerbach, Dr. Straubel, and their wives. . . . I was received most cordially, and was introduced to the company, and drank Sunday afternoon coffee with them. Then Professor Abbe proposed a walk, and we set out up the ' Philosophen-weg ' which winds up the hill-side, toward the old battle-field to the north-west. It was fine, and quite hot. Beds of purple anemone we found on the hill-side. We wandered about leisurely, visited the Napoleon-stein from which tradition says that Napoleon watched the battle. Then went on to a little village to find the inevitable restaurant, where we drank a villainous decoction, seemingly a hybrid between bitter-beer and lemonade. Then we turned homewards, and divided as we neared the town. Dr. and Mrs. Straubel took me off to supper. Dr. Straubel is assistant to Professor Winkelmann—Professor of Physics—in the University. They are very pleasant folk, and own three small boys, the eldest a ' Bubbles ' of about five years, with whom I made great friends. He claimed me as *Onkel* forthwith. Abbe holds a most extraordinarily high place in the esteem of the good people of Jena. He came to Jena about 1869, as Professor of Astronomy. He found an optician of the name of Carl Zeiss, with about a dozen workmen under him, in the town. He helped Zeiss by advising him about his instruments, calculated new lenses for him, tested his microscopes and adjusted them, finally became his partner, and then, when he died, his successor. The firm of C. Zeiss now employs over 1,000 workmen, and Abbe is director. Also he created the glass-works of Schott & Co. for making optical glass. And the glass-works of Schott—founded in 1886, now employ also about 1,000 workmen. Abbe owns half this concern. But now comes the most extraordinary thing ;

Abbe has turned the firm of Zeiss, together with his share in the Schott glass-works, into a 'Carl Zeiss Stiftung,' that is to say, into a sort of Socialist Company, in which all the work-people are co-operative owners. He, who might be deriving an income of £6,000 to £8,000 a year, simply draws a salary of £600, as do also his three co-directors. All the other profits are divided amongst the employees. And it is arranged that, whenever Dr. Schott dies, his concern shall entirely merge into the Carl Zeiss Stiftung. They say that 5,000 souls depend on these two concerns; that they are very prosperous; that the social style and civilisation of the work-people is far above the average in Germany, and that the growing prosperity of Jena is directly attributable largely to the genius of Dr. Abbe.

"No wonder they honour him.

"As it was wet and stormy, I stopped indoors after breakfast, and did some writing. Just before noon the day cleared up, and, though it is very windy, it is bright. So I went out for a brisk walk along the high-road up the Mühle-thal back towards Weimar. . . . A letter has just come from Elder, saying that he finds to his dismay that . . . he can't get through his business by Tuesday night, so won't be able to come on here.

"Outside the window of my bedroom is a tablet which has the announcement: 'Hier wohnte Dr. Martin Luther, 1522.' In the next room to mine Bismarck stayed in 1892. This also is commemorated by a tablet outside, and by a silver plate, inscribed, upon the bedstead.

"Many of the houses in Jena bear tablets. The former residences of Hegel and Schlegel and Fichte and Wieland and Schilling are all marked. Goethe appears to have lived in four or five houses. I crossed yesterday the path where he walked up and down when composing the *Erkönig*. To-day the two great men in Jena are Haeckel and Abbe. There is an Ernst Haeckel Strasse, in which his villa stands. Abbe lives at No. 7 in Carl-Zeiss Platz."

"April 19th.

"I have had a busy morning. First with Dr. Pulfrich at Zeiss's works, showing me the optical laboratory; and afterwards with Professors Straubel and F. Auerbach in the Physical Laboratory of the University.

"Yesterday was also a busy day. In the morning, which was fine but cold, I took a walk along the Unterer Philosophen-weg in the north-east direction, and explored some

pretty little villages running from the river towards the battle-field. I found several plants that were quite unknown to me ; one a thistle (I think) with wonderfully decorative leaves. I came back for middle-day dinner, and then went about 2.30, to Professor Abbe's house, where I had coffee with him and Mrs. Abbe. Then he took me across the road to Zeiss's factory, where I spent most of the afternoon. I saw their lens-grinding and lens-polishing machinery, and the room where they test the photographic lenses. I met Dr. von Rohr, Dr. Rudolph, and Dr. Pulfrich, all men of distinction in scientific optics, and all employed in this firm. After I had finished this tour of inspection I had a walk by the river-side, and then returned for a short time to The Bär [his hotel] before going to Professor Auerbach's house to supper. We were a party of seven—Professor and Mrs. A. (both of whom have been in England), Professor and Mrs. Abbe, and Professor and Mrs. Straubel. We had a very pleasant evening, talking of German literature, of the reform of the Universities, and of minor arts, including photography, in which Mrs. Auerbach is an adept. I find that my book on Faraday is read and appreciated here.

"I go this afternoon to see Schott's glass-works ; then for another little walk, and to supper with Dr. von Rohr. To-morrow I go on to Eisenach, the first stage of the return homewards."

"EISENACH,
"April 20th, 1900.

"It has been hot—hot as July to-day. I had a little walk, while it was yet fresh, after breakfast, across the 'Princessin Garten' and near the old fortifications of Jena. And then once more I went to Zeiss's optical works to select some prisms for the laboratory at Finsbury, and to chat with some of the scientific men at Zeiss's works. Two of them, and Professor Auerbach, came back to lunch with me at the Schwarzen Bären ; and after lunch I called on Professor Abbe to say adieu.

"I reached here a little before 7 p.m., and took a walk up to the Wartburg while it was yet twilight.

"The town is dressed in festival array with arches and decorations ; for they expect the Kaiser to-morrow. I did not know of this. I think I shall not trouble myself about his Imperial Majesty, but shall (after seeing the interior of the Wartburg early in the morning) take a long walk over the Hørselberg to hunt for relics of the stout knight Tann-

häuser. It will be a ten-mile walk, and much better worth seeing than the erratic monarch of these parts. There is evidently some very fine forest all about: and Baedeker is a sufficiently detailed guide to be of use.

“Possibly I may be home before this letter is delivered.”

In the summer of 1900 was the great Exhibition in Paris; and there again Thompson was brought up against the German optical industries in the exhibit where “the advanced state of certain branches of optics in Germany was revealed by that most remarkable catalogue of the collective exhibit of the opticians and instrument-makers of Germany.”

These things which he saw abroad aroused his patriotic ardour, for he was made conscious of the fact that his own countrymen were lagging behind in this department, and he would not have it so. “Not that we are to take German methods and copy them. England has to work out its own problems in its own way.”

Thompson had early shown himself thoroughly alive to the broad national aspects of his subject, optics. There is a letter dated December 1891 from the superintendent of the Observatory at Kew saying:

“Mr. Galton and Major Darwin were down here yesterday as a lens-testing sub-committee, and we discovered your kind letter just to hand. Darwin had talked over the matter of the term *astigmatism* with Abney, and decides that you are right, and that it ought to be changed. Galton is also of that mind, but Abney is decidedly averse. As the latter is abroad for a while the question must wait for his return, meanwhile if *aplination* or *aberrancy* is introduced into optical terminology, we will make note of it. Personally, I agree with you in preferring the first term.”

Thompson used to be very emphatic about the importance of the right use of terms to avoid confusion of thought.

Of national importance too, in Thompson's opinion, was the raising of the status and the training of members of the optical industries. A beginning had been made by the organisation of examinations for opticians and the granting of certificates by the British Optical Association. This was followed by a revival of activity in the ancient guild

known as the Spectacle Makers' Company, which led to this body also founding a scheme of examinations. Early in 1898 plans were completed, and the Upper Warden of the Guild, Mr. H. E. Thornthwaite, F.R.A.S., one of the keenest supporters of the movement, undertook (the master for that year being the Lord Mayor), to enlist the aid of some eminent scientist to act as a third examiner in conjunction with two members of the Company. Sir William Crookes was first approached, but work for the British Association and a prospective voyage prevented his assent, even to dividing the work with Thompson, who was next asked. He accepted, and so from the beginning had the honour of being associated with the Spectacle Makers' Company in its endeavour to stimulate opticians to acquire proficiency in the technics of their craft by offering to those who passed the examination a diploma and fellowship in the Company.

The city press evinced considerable interest in and approval of the activities of the Guild, and the examinations, two in the year, were well patronised by members of the trades both in and outside London. The Master wrote gratefully to Thompson of all he had done, which had added so much success and *éclat* to the scheme. At the beginning of the second year, 1899, Thompson was admitted to the fellowship of the Spectacle Makers' Guild, and became a freeman of the City of London. The Guild had an influx of distinguished supporters of its efforts in Mr. Christie, the Astronomer Royal, Sir William Crookes, Lord Kelvin and Captain Abney.

Many of the ophthalmic surgeons of the country looked somewhat askance at the new movement, and the organisers realised that they must walk warily. The Master of the Company attended in person many, if not all, of the earlier examinations, and addressed the candidates on the use and abuse of the diploma, the standard of which, it was intended, should be maintained at a good level.

After two years Thompson offered to resign his post of examiner, and at the same time analysed his experiences and offered advice on the scheme, demanding evidence of better preliminary training from candidates.

He was really thoroughly interested in the scheme, and continued his work as chief examiner for some years more. His colleague for many years was Dr. G. Lindsay Johnson, F.R.C.S., the ophthalmic surgeon. They both had considerable qualms when the Guild decided to accede to the desire expressed through Lord Kelvin and other eminent men, and added to the scheme a diploma in sight-testing, and the recognition of a diseased condition of the eye, which had at first been regarded as the work of the qualified medical man. A committee of enquiry had been employed, for neither of the examiners would have consented to act without a reasonable guarantee against abuse of the diploma for the granting of which they were responsible. But common sense expressed the view that, as the general public had since the beginning of spectacles gone to the optician to be tested (after a fashion), and fitted out, it was not likely that that habit would alter, and it was much better that the opticians should have the stimulus of the Fellowship of the Guild, which also could be made, in some degree, a safeguard against imposture. When Thompson retired in 1908, under the pressure of work on the Kelvin biography, he was succeeded for a time as chief examiner by Dr. R. T. Glazebrook (afterwards Sir Richard Glazebrook).

The increased educational activity in the industries manifested itself in the establishment in 1900 of an Optical Society for the discussion of scientific and technical matters. Thompson was elected one of the two first Vice-Presidents, and gave their first lecture, inviting the members to meet at Finsbury Technical College, where he could conveniently demonstrate to them phenomena which he classed as "Aberrations." In his lecture he referred to the theories of Professor Siedel of Munich, whose German publications were largely unfamiliar, even to the leading opticians in this country. He lectured to them on other occasions, but he was not able to give any time to the organisation of the Society, and retained his official connection only under protest, until in 1903 he, with Dr. Glazebrook, was shown the appreciation felt for services rendered, and the confidence won, by election as the first honorary members of the So-

ciety. In the year of his Presidency two more distinguished names were added, Lord Kelvin and Sir William Christie, the Astronomer Royal.

The subject of "opto-technics," as Thompson termed all the questions relating to the training of opticians, was a matter of great concern to him, and he devoted much time and energy to elaborating one of his comprehensive surveys of the whole subject, which he delivered in a lecture at the Society of Arts in April 1902. Dr. R. T. Glazebrook, F.R.S., Director of the National Physical Laboratory, was in the chair, in the absence of Sir Wm. Abney, and at the close of the lecture "pointed the moral and adorned the tale" with all the weight of his position at the head of the institution whose function it was to foster scientific research and ensure technical perfection in the very important matter of scientific instrument construction.

In his lecture Thompson stated what facts were known about the condition of the optical trades, which, he estimated, employed perhaps 20,000 persons in the London district alone, outlined the necessary foundations for any sound technical knowledge of optics, and the subsequent course of study advisable for a would-be expert optician, then proceeded to the question how the English worker was to obtain these. He analysed the statistics provided for him by the Board of Education, showing the rapid decline of numbers of students in the classes in optics all over the country since 1890, which he attributed largely to the failure to meet the practical needs of would-be opticians; there were no teachers with the requisite knowledge of *opto-technics*; and the need for them was quite as great as for the then fully recognised teachers in recognised institutions for *electro-technics*. He had at one time hoped that a special department might have been added at Finsbury Technical College, and had drafted a scheme for the establishment of one as early as 1886; and later, when the London Polytechnics were being established, he had hoped for an Optotechnical Institute at Clerkenwell, the district in which the trades centred, holding the view of these institutions "that the less they have of *poly*, and the more of *technic*, just so far

have they benefited the industries." From this point of view he warmly commended the special optical work of the Northampton Institute in Clerkenwell.

His experience in the Spectacle Makers' Examinations convinced him of the immediate necessity of establishing some proper system of education of opticians, and he urged, as a matter of national importance, the foundation of a real *Optotechnical Institute*, properly equipped and staffed with picked men, and responsible for a "respectable optical journal." He lamented the lack of good optical literature in English, and his opinion in this matter was endorsed again and again by opticians. The whole scheme outlined by Thompson in the paper met with approval and support from all parties present at the meeting, representatives of the trade in various branches, and academic and technical teachers of optics. To the question how such an institution was to be brought into existence, he replied by asking why the men in the optical industries did not request that the money which was granted annually to the Technical Education Board of the London County Council, and not used, should be spent in the instruction of opticians.

Thompson's work bore fruit by very slow degrees. In 1902 a deputation of the Optical Society was received by the Technical Education Board, and strongly advocated the provision of further facilities for instruction in technical optics; and next year a separate department was formed at the Northampton Institute, "with the assistance of the Technical Education Board of the L.C.C." The Optical Society had earlier shown itself alive in this matter, having appointed an Education Committee, and the members had subscribed every year to the support of the classes of the Northampton Institute. This was the only local support the Institute had during the years of chaos that followed in London Education, when the 1903 Act abolished the Technical Education Board, and the official administration of all funds passed into the control of the Education Committee of the L.C.C.; and little money went the way of "opto-technics," though the work had been specially commended to the care of the new authority by the old.

The question of proper provision was, however, not allowed to rest. In 1905 the first Optical Convention was organised in London for the exhibition of the work of the trades, and for the holding of discussions upon problems of interest and importance.

Consequently the position of President of the Optical Society for that year was likely to entail additional work. Thompson was chosen, but was very reluctant to accept the burden of the honour. He would have preferred to have seen a member of the trade in the position, had the verdict of the Society not been in favour rather of a man of academic standing for this occasion.

The year before Dr. Glazebrook in his Presidential Address had dealt with the work of the Society under three heads: co-operation, education, standardisation. The last of these was his own special field of work. Though well qualified to speak upon the second, Thompson took up a quite different line in his address, and gave a discourse upon "The Early Literature of Optics," illustrated from his own library.

The Convention was held in May 1905, under the Presidency of Dr. Glazebrook, and was very successful. The most important outcome of it was perhaps the stimulus to the interest in education. Dr. Mullineux Walmsley read a paper on "The Present Position of Education in Optics," quoting frequently from Thompson's lecture to the Society of Arts. The Convention drafted a resolution in favour of the establishment of an "Optical Technical Institute," and sent a deputation to the L.C.C. Education Authority, headed by Dr. Glazebrook, with Mr. Conrad Beck as spokesman for the trade, and Thompson for the Optical Society.

Five years later, in September 1910, the Education Officer of the L.C.C. instituted an enquiry. Thompson was one of the witnesses. This was followed by a conference at which he was present as one of the nine outsiders invited to assist. An elaborate report, thirty-seven quarto pages, was issued in March 1911, and then the matter was dropped. Meanwhile, the Northampton Institute work went on, cramped in funds, cramped in equipment, uncertain of the future.

It was suggested in the extensive report that the more advanced instruction and the research work would be better under a separate department, and that the best place for this was the recently established Imperial College of Science and Technology of which Sir Alfred Keogh, K.C.B., was Director. Shortly after the Conference with the L.C.C. Sir Alfred wrote to Thompson :

“ January 11th, 1911.

“ I am now returning your copy of *The Journal of the Society of Arts*, having read very carefully and more than once your paper on Opto-technics and the discussion thereon. It is a strange thing that nearly nine years has elapsed, and practically nothing has been done. As far as I am concerned the position is this. It is now proposed to realise your ideal, and to do this by the establishment of a separate school, or of a special department in Dr. Walmsley's Institution. . . . Towards the establishment of the department I can of course do nothing. I only want to say to you now, that if the Imperial College is required to take a part in the work that part will be taken. I am prepared to go a long way towards helping this important work. I may therefore be called upon to any extent. I can say no more.

“ I do hope action will not be delayed.

“ Very many thanks for giving me the opportunity of becoming acquainted with the necessities of the case.”

Still no Institute of Technical Optics was founded.

The English were not alone in their efforts, and in other countries Thompson was a recognised authority. In 1902 he received a letter from a French author, who was preparing a book on *Les Écoles pour les Opticiens*, and who applied to him for information about certain points in English affairs ; and in 1910 he was consulted by a representative of the Bureau of Standards of the Washington Department of Commerce and Labour when, there too, the question of improving the quality and increasing the quantity of optical manufactures and improving facilities for instruction in technical optics began to exercise the more advanced spirits of the U.S.A.

During these years of endeavour to make the cumbersome machinery of bureaucracy move a little faster, and in a new

direction, Thompson did a certain amount of other optical work. In 1901 he delivered at the Exhibition of the Royal Photographic Society at the New Gallery the fourth annual "Traill Taylor Memorial Lecture," for the enlightenment of photographers in the essential science of their art. His subject was "Zonal Aberration," a defect of lenses that is of importance to users of cameras. A paper on this subject was published also at Haarlem in Holland; and the same year he was preparing a paper, in Italian, "un paradosso ottico," which Professor Righi, as President, proposed should be read to the Società Italiana di Fisica, and wrote trying to persuade Thompson to be present himself at the meeting in Brescia early in September.

In 1902 he received certain recognition of his optical work from the Royal Society in the form of a request to write the biographical note of the deceased Foreign Member, Alfred Marie Cornu, a leader in optical research, and one of the most distinguished scientists of Paris.

Another little bit of biographical work done by Thompson was the account of William Nicol with which he concluded his paper to the first Optical Convention "On the Nicol Prism and its Modern Varieties." He wrote to *Nature*, and obtained a good deal of information in answer to his questions there.

This paper was given as the one rather formal Evening Lecture of the Convention, of which most of the time was devoted to discussions at sectional meetings. At this Convention, besides acting in his capacity as President of the Optical Society, Thompson was chairman of the papers sub-committee. Dr. Glazebrook wrote to him that his appointment to this position was "one of the various things which will I hope advance the cause."

This first Optical Convention, held at the Northampton Institute, and lasting from a Tuesday to the following Saturday, brought people from all parts of the country, and was considered so much of a success that it was decided to repeat the experiment whenever opportunity ripened. In 1908 it was quite hoped that a meeting would be held the next year, and Thompson accepted the nomination as

a Vice-President. Sufficient support was, however, not forthcoming, and it was not until 1912 that plans for the second Optical Convention matured, and on this occasion Thompson was elected to serve as President. His near neighbour, Mr. J. W. Gordon, was the Honorary Secretary, and they both had a busy time and many consultations long before the week set apart for the meetings. Having prepared a statement of the aims and achievements of the 1905 meeting, and obtained the support of nearly all the important scientific societies, they approached the Board of Education for leave to use rooms at South Kensington Museum, and this they eventually obtained, with the Lecture Theatres of the Imperial College of Science and Technology for the holding of lectures and discussions. The exhibition itself was representative of British industries, and the advance in their position was shown in the catalogue, which was not only much larger, but was published in French and in German for the information of foreign purchasers of English optical wares. Apart from the industrial exhibits were some of special historical and educational interest. Thompson had made himself responsible for an "Isaac Newton" room, in which he had set up apparatus modelled upon the descriptions given by Newton in his *Optiks* of the arrangements which he himself used in some of his principal experiments. Towards the expenses of this exhibit Thompson appealed for and obtained the financial assistance of the Worshipful Company of Spectacle Makers, whom he was again serving as chairman of the Examining Board. He had also sent to the library exhibit his collection of nearly fifty volumes, "the classics of optical literature," many belonging to the sixteenth and seventeenth centuries.

Except for the exhibits of historical interest the display was confined entirely to British industries. There had been suggestions of including a Foreign Section, but this was eventually not carried out. Thompson, who always upheld the international aspect of science, hoped to have had the assistance of representative men of other countries, and wrote both to German and Italian friends, inviting them to

take part. He was again chairman of the papers sub-committee, and contributed to the Convention a joint paper, with Professor Coker, on "The Design of Large Polariscopes," and one on "The Trend of Geometrical Optics," an extension of his work on the Measurement of Lenses; these in addition to his Presidential Address, which was reported thus in *Engineering*:

"The address of Principal S. P. Thompson was a brilliant inauguration, worthy of the occasion, and abounding in weighty suggestions. We intend to reproduce it in our next issue. It was a long address, and its delivery took more than an hour. It would be useless to attempt to abstract it; we can merely pick out a few salient points. Characteristically he dealt at first historically with his opening theme, the value of theory to practical advances, returning again to 'the two giants, Newton and Huygens,' to illustrate his points. Modern optics he classified into forty groups of phenomena, and reviewed progress in various of these, referring to the books and researches of his brilliant contemporaries. In conclusion, he pleaded for an institute in which optics should properly be taught, in which brain-craft and handicraft were united, not two separate schools for calculation and for workers, not under the baneful influence of a University. The optical industry was in deadly earnest in demanding such a centre of optical training."

Before the Convention took place Thompson was very hard at work preparing for publication his translation of the *Traité de la Lumière* of his second "giant of optics," Huygens. This book was ready in time to bring it before members of the Convention to whom, in order to encourage them in the study of good optical literature, by agreement with the publishers, Messrs. Macmillan & Co., it was offered at half its published price. This work was described in *Science* the following year, 1913, in a review signed H. C.:

"Ever since its birth, in 1690, the wave theory of light has been adapting itself to environment. Just at the present moment . . . an English translation of Christiaan Huygens's great *Treatise on Light* is particularly opportune. The fact that this translation has been made by Professor Silvanus P.

Thompson is an ample guarantee that it has been done in a scholarly and sympathetic manner. Two distinct courses are open to one who wishes to transfer into English the thought of a foreign author, who lived more than two hundred years ago: either he may employ the English phraseology of our own day, or he may use that which he conceives to have been the current diction of the period in which the work was composed. In either case he must avoid anachronisms, and in either case the problem is difficult. . . . It is the second of these alternatives which Professor Thompson has chosen. The result is that the volume, including its title-page, table of contents, text, paper, binding, typography, size, and English style, is as nearly as possible what it would have been if Huygens had lived and worked and published on the other side of the English Channel. This is not to be understood as meaning that the translation is in any sense a literal one, for it is precisely the spirit of the work which Professor Thompson has caught, and has faithfully reproduced. In brief the volume is in every way worthy of the great contributions to science which it contains."

This was Thompson's last considerable contribution to optics. In 1912 he again rendered service to the Spectacle Makers' Guild, when this body was inaugurating a special series of lectures on the study of elementary optics and sight-testing. He delivered the first, on Lenses, showing experimentally the ill-effects of aberrations, and the methods of eliminating these for various purposes, a study which, though admittedly far from the simple optics of the spectacle dealer, was in his opinion of first importance in optical industry of the present day. In 1913 he again examined the candidates, and passed the thousandth diploma since the scheme was inaugurated.

In 1915 Thompson thought the time had come to urge upon the Guild once more the necessity of taking immediate steps, without waiting for the end of the war, to organise the teaching of optical science. He considered that the success of its examination scheme and its position as recognised and most ancient head of the industry fitted the Company to take direct action in this work of national importance.

For the war found the English still without a well-equipped school of technical optics.

When nothing came of the conference at the L.C.C. in 1911, hopes were turned in the direction of a Departmental Committee of the Board of Education, appointed to consider the carrying out of the proposals of the Royal Commission on London University. Thompson knew many of the members of this committee through his previous work in university affairs, and as Senator; but he had ceased to hope for much there.

The next move, early in 1914, was taken at the instigation of Sir Thomas Barlow, when the aid of the British Science Guild was enlisted to assist in relieving the difficulties of the Northampton Institute, and to emphasise the needs of the general trade in optical instruments, as well as those of the Admiralty and War Office. Thompson was elected chairman of the Technical Optics Committee of the British Science Guild, and this body was about to approach the Development Commissioners in the fateful month, July 1914, when Thompson had already gone to the Dolomites for an earlier holiday than usual.

England had long ago depended upon imports of glass of all kinds to supplement her scanty home resources. The war rendered the shortage alarming, and at first all thought turned in that direction; but in December 1914 the Committee of the Guild once more urged the educational needs of the industries upon the authorities.

In the spring of 1915 the L.C.C. took up the scheme again, and Thompson corresponded upon the matter with Dr. William Garnett, the technical adviser, and was invited by the Education Officer to be present when the representatives of the trades assembled to discuss the proposals with him. When at last the hoped-for scheme was declared ready for adoption, Thompson was missed in the public gathering, and his loss deplored by the chairman.

Apart from his interest in distinctively optical questions such as the foregoing, Thompson showed himself alive to other aspects of the study of Light, in particular to the questions involved in the supply of the best possible artificial illumination.

He had been early engaged in the electricity *versus* gas-light controversy and watched the developments of both with keen interest, writing from time to time to the press when some particular point was in question on which he held definite views that others had not expressed adequately.

In 1893, the year of the publication of Thompson's *Notes on Photometry*, Sir William Preece, as Engineer-in-Chief of the Post Office, undertook to organise a committee in England to act with a similar committee in the U.S.A. to consider and determine if possible the question of a Standard of Light and a Standard of Illumination, and invited Thompson to become a member of it, together with Abney, Hopkinson and Fleming. In this capacity Thompson saw Helmholtz, for, as Sir William wrote to him, "It is very important to get co-operation with our German friends, and I will write to America suggesting the formation of a German Committee." These committees were doubtless the precursors of the International Photometric Commission, which was active at Zurich in 1911.

When asked in 1906 to deliver "the Working Men's Lecture" of the British Association at York, he chose as his subject "The Manufacture of Light," which lent itself well to experimental illustrations on a large scale, including a photometer which extended right across the platform. The lecture was very successful; though it provoked much less enthusiasm than the previous one in Bradford (see pp. 73-4), it satisfied at least one of the audience, Mr. J. W. Graham of Dalton Hall, Manchester University, who wrote years afterwards that he did not remember ever listening to so good a lecture as this one. Thompson published it as a booklet, and afterwards incorporated it as an additional chapter in the second edition of *Light Visible and Invisible*. It sets forth the claims of the rival systems of lighting and concludes with the paragraph:

"*Sunlight after all.*—No, the cheapest source of light still remains to be the commonest and most universal, the light of the sun, which shines alike on rich and poor, and gives us—such is the admirable economy—a light of which

the dominant wave-length is . . . just that to which our eyes have become, in the long evolution of the ages, the most sensitive. By no artificial process can we manufacture light so cheaply that it would not be still cheaper to adjust our social habits to the hours of sunlight, and do our day's work while it is yet day."

Thompson always hoped the nation would adopt "day-light saving," and lived to enjoy a few weeks of the prolonged summer evenings.

Early in the twentieth century a movement arose among enterprising spirits in the various branches of "illuminating engineering" in England and America, who got together to discuss matters of interest to both gas and electricity workers, and published a monthly journal to expound the position and the problems.

Within two years a society was formed in England, having the support of a number of well-known men. Thompson was approached with the request that he would become the First President of the Illuminating Engineering Society of Great Britain. The founders sought "one who is in sympathy with our movement and has taken a wide interest in light, illumination, and illuminants generally."

From its inception the Society was supported on the Continent and in America by many corresponding, as well as ordinary members, and Vice-Presidents; and at the first anniversary dinner at the Criterion Restaurant there were present representatives of many "kindred Societies," the Royal Society of Arts, the Physiological Society, the Royal Sanitary Institute, as well as the Gas and the Electrical Engineers.

In his Inaugural Address, delivered at the first meeting of the Society in 1909, Thompson set before the assembled members his views as to the aims and objects of the Society and proposals as to its future work.

"The Society has been founded to bring together all those who are interested in the problems, practical and theoretical, of the art of directing and adapting light, that prime necessity of civilised, as well as of uncivilised existence, to the use and convenience of man. By day the sun,

by night the artificial sources, lamps of all kinds, provide mankind with light. But to utilise the light so afforded, properly, without waste, without excess, is an art, a business, concerned with many more things than the mere production of light. Few members of the community at large are producers of light, and those who produce light have many diverse and often rival processes. But all members of the community are users of light. And between the producer and the user there stands a considerable number of persons, mostly professional men, not middlemen in the industrial sense, but persons who are concerned with the intermediate questions of distribution and utilisation for whom no professional name has hitherto existed, and who have had no organisation to bring them together to consolidate their experience or to voice their opinions. Their diverse and individual interest centre around a common topic—and, in default of a more appropriate name, that topic is called ‘illuminating engineering.’”

He summed up the present position thus: “The ascertained facts are few—all too few; their significance is immense; their economic and social value great; but the ignorance respecting them generally is colossal!” He put before them a few of the facts known, suggested a few specific questions in which he saw a hopeful field for investigation, and proposed that the Society should work, like the British Association, by forming technical committees, charged with the duty of preparing reports on the different branches of the subject. He went on to deal with the subject of school-lighting, and referred to the statistics as to the light arrangements of the L.C.C. schools, and the reports of ophthalmic surgeons, in particular that of his brother Dr. Tatham Thompson of Cardiff, on the eyesight of school-children. He hoped architects would find a place in their Society. Among the many other problems he referred to was the long outstanding one of the production of light without heat—accomplished in nature by the firefly or glow-worm. “There is, indeed, abundance of work before us. . . . To sum it up, the work before us is *to diffuse the light.*”

The year following, 1910, when invited to lecture at the

Royal Institution, Thompson chose as the subject of his course, "Illumination Natural and Artificial," and there elaborated his theme.

Following the suggestions of their President, the Illuminating Engineers established committees of enquiry into the questions of street, school and library lighting, and kept in touch with groups of interested workers abroad. In January 1912, when a proposal had come from the American Society to hold an International Conference on questions of Photometric Nomenclature and Standards, a meeting of representative persons was summoned to the National Physical Laboratory, and in the absence (owing to illness) of Dr. Glazebrook, Thompson presided over their deliberations, and so once more became associated with international enterprise. At the time of his death he was a member of the National Illumination Committee of Great Britain, which existed as a representative body, affiliated to the International Commission on Illumination.

At home the Society engaged in useful activities. In 1913 Thompson was still the President, and in that capacity served as Vice-President at the National Gas Congress and Exhibition held in London under the presidency of Lord Rayleigh. Conferences were held both this year and the next with educationists and persons interested in school-lighting, and with architects on the subject of the lighting of museums and libraries, and on both occasions Thompson gave up a Saturday afternoon to open the discussion with an introductory paper. ~

Of his work for the Illuminating Engineering Society, Mr. Leon Gaster, its secretary, wrote in the following terms,¹ a few weeks after Thompson's death :

"In presiding at the Annual Meeting, he spoke with all his accustomed charm and idealism, encouraging us by pointing out how many of the aims and objects of the Society—so admirably expressed in his own Inaugural Address in 1909—were gradually being carried into effect. We cannot do better than quote from what we now feel to have been a farewell message :

¹ *The Illuminating Engineer* (June 1916).

“ ‘The whole function of the Society is to produce good lighting by whatever means, and the fact that Departmental Committees and officials of the Home Office are now persuaded, and more than persuaded, that this is a step to be fostered governmentally is a complete justification for the existence of the Society. This, however, does not justify us in folding our arms and saying that our work is done, but it is an encouragement to go on in the future in the same direction and improve lighting of all kinds for the benefit of the community.’ ”

“To the Illuminating Engineering Society he endeared himself by his conscientious execution of his duties as President, and the admirable way in which he smoothed away conflicting interests—always cheerful and optimistic, with a generous recognition of the services of others, and a kind thought for all with whom he came in contact. He seemed by instinct to know the right thing to do and say on each occasion, and it was in no small measure owing to his influence in the early stages that the Council Meetings of the Society have, from the very beginning, been carried on in such an amicable and friendly manner.”

CHAPTER XIII

THE WRITING OF THE KELVIN BIOGRAPHY

It was during his student days at South Kensington in 1876 that Thompson first met the man who became to him in later years almost as great a hero as was Michael Faraday.

In the spring of that year he wrote home to his father narrating how, when one day, in the machinery hall of the Inventions' Exhibition, which was then going on, he met, along with some other scientific men whom he knew, Sir William Thomson of Glasgow, the celebrated Professor of Natural Philosophy, and great mathematical genius. He had also heard him discoursing on some electrical apparatus which was on show.

In the same year Thompson went during the autumn to Glasgow to attend the meeting of the British Association there. At this meeting Sir William Thomson was President of the Mathematical and Physical Section, and his wonderfully patient, courteous, and encouraging manner towards the younger men, who were making their first attempts to bring forward their own results of researches and experiments, made a deep impression on Thompson. From that time onward he held a high opinion of his character.

Although never privileged to be a worker under Sir William like Professor Ayrton, Professor Ramsay, and some of his other friends, yet Thompson soon grew to have the same warm affection, and the same reverence and admiration for him, that so many of them felt. During the seventies and eighties, while he was still an aspirant for success in research work, he very frequently received most kindly encouragement and signs of interest from him, whom he named privately the "Second Isaac Newton."

Sir William Thomson himself a few years later seemed to feel the attraction of the younger man's keen and earnest personality.

He also early recognised the value of his work on optics, and it has been already shown how much he appreciated his work on light and radiations.

When the two men met at scientific social gatherings they sometimes entered into animated discussions on subjects in which they were both interested, and became quite oblivious to their surroundings.

A rather amusing scene arose out of this on one occasion, which Thompson mentions in his *Life of Kelvin*.

Sir William Thomson was President of the Royal Society from 1890 to 1894, and in 1892 he was made a peer, and took the title of Baron Kelvin. During that year's office he and Lady Kelvin were receiving the guests at the Annual Ladies' night Soirée in the Royal Society's rooms, and were standing near the door of the room at the top of the staircase. As soon as Thompson and his wife were announced, and had shaken hands with their host and hostess, Lord Kelvin grasped Thompson's arm, and hurriedly drew him to one corner of the room, and, pointing up towards an electric light, he said quickly: "Look at that lamp: now half shut your eyes: tell me what you see." Thompson said, "I see irregular luminous streaks extending above and below." "What are they due to?" he asked. Thompson explained that he always "supposed them to be due to the film of moisture at the edges of the eyelids, acting as an irregular cylindrical lens." "Where did you find that? Who told you that?" Kelvin asked excitedly. Thompson was just beginning to say that he had known it for a long time, and had been giving that explanation to his students in past years, when Lady Kelvin, who with Mrs. Thompson had been noticing with some consternation that several more guests had arrived, and were waiting to be received, put her hand on his arm and said, "William, there are people waiting." As Kelvin hobbled back to his former position (he was then very lame), in front of the door, he said, "I want to talk to you about this later."

Afterwards he told Thompson that he had been reading some papers belonging to his late brother, James Thomson, Professor of Engineering at Glasgow, who had died in May of that year, and had found an explanation of this phenomenon, which he thought had never been published. Now he considered it was not worth while to publish it, as Thompson had been teaching it to his students for several years.

Another time Kelvin met Thompson on the stairs leading up to the gallery of the Natural History Museum. A Soirée of the Institution of Electrical Engineers was in progress, and it was the most crowded time of the evening, when hundreds of people were going up and down the broad staircase. He began asking Thompson about something which required a somewhat lengthy explanation, and the two absorbed scientists, and their two patient wives, continued to be for some time a serious block to the passers up and down, and were the cause of many smiles of amusement on the part of those who were familiar with Lord Kelvin's little ways.

In 1896 the jubilee anniversary of Kelvin's appointment as Professor at Glasgow University was celebrated. It took place in June, a time when many universities are not in session, and was attended by an extraordinary number of their representatives from all over the civilised world.

Thompson was one of those presenting addresses, and and he and Mrs. Thompson were present at the ceremonies, of the presentation, of the granting of honorary degrees to many of the foreign professors, and the reception of the delegates and their friends in the Bute Hall by Lord and Lady Kelvin in the evening.

Three years later Kelvin retired from his professorship, and went to live at Netherhall, Largs, a house which he had built for himself. After this he was much more frequently in London, and had a house in Eaton Place, where he sometimes spent several months of the year.

During Thompson's Presidency of the Institution of Electrical Engineers it was his pleasant duty to inform Lord Kelvin that he had been elected an honorary member of the Institution.

He received the following letter, dated January 17th, 1899 :

“ I warmly appreciate the personal kindness of members of the Institution of Electrical Engineers in wishing me to be its first honorary member, and I beg you to convey to the Institution my cordial thanks for the resolution to confer on me this distinction, which you tell me has been adopted.

“ I value the honour very highly, and shall ever continue to be fully interested in the work of the Institution and its ever-increasing usefulness.”

In 1904, when Colchester was having its Annual Oyster Feast, and the Mayor was anxious to include several electricians at the dinner, he asked Thompson, who was a personal friend, to try and get Lord Kelvin to honour the feast by his presence.

Kelvin replied from Largs, September 8th, 1904.

“ DEAR THOMPSON,

“ I have been at an oyster feast before. Lord Rayleigh, who was then Lord-Lieutenant of Essex, was at it also, and it really was very interesting and amusing. It has also the merit of time-honoured antiquity. Will you thank the Mayor for his kindness in thinking of inviting me this year ? It would have been a great pleasure to me if I could have accepted, but my whole free time will be taken by several important and unavoidable engagements in Scotland and England at different times during the month (October), which make it practically impossible for me to have the pleasure of being one of his guests at the Cyster Feast this year.

“ I am feeling less and less satisfied with the orthodox explanation of the radiometer : that the motion is due solely to the difference of temperature on the two sides of each vane, and its influence on the molecular impacts of the enclosed air. Do you know if any one has published anything with respect to the cup radiometer ?

“ It is exceedingly difficult to see how the difference of temperature explanation could be applied to this.

“ I have had a little cup-radiometer since 1881, when I was staying with Helmholtz in Berlin, and bought it there. I don't remember his having any explanation for it. I had the impression that its action was not very satisfactory ;

but yesterday and to-day here, I have been trying it and finding it just about as sure as an ordinary radiometer, though it does not go round so fast.

“Yours very truly,
“KELVIN.”

Thompson replied to this on September 11th :

“DEAR LORD KELVIN,

“I have written to the Mayor of Colchester of your decision. I know he will be sorry that you cannot come to the Oyster Feast.

“As to the radiometer question, the cup form of radiometer has never seemed to me to depend on exactly the same facts as the ordinary one that has one set of faces blackened. In the case of the blackened faces, something happens at the face which, whether it penetrated deeply or not, *must* be equivalent to a rise of temperature. Possibly it is confined only to a very thin layer of molecules. May it not be somewhat similar to that which occurs in the phosphorescence of rubies (for example) in a Crookes’ tube? Is not the surface layer of molecules, which is emitting this phosphorescent light, actually and truly red hot?

“That is, these molecules are in the same intense vibration as they would be if the temperature of the whole mass were to be raised to 800° C., or more. Then the layer of molecules on a radiometer vane *must* be raised in temperature by the radiation that falls on them, and those surfaces that do not reflect much of the radiation must be thus raised in temperature more than those that are good reflectors. But then not even a blackened radiometer will revolve, unless there is within reasonable distance an opposing bulb wall. The same vanes that run round quickly in a small bulb run round quite slowly in a large bulb, with the same vacuum and under the same illumination.

“Hence, when one goes to the case of the cup-radiometer, where there is no apparent reason for any difference of temperature between a convex and a concave face of equal polish, the only thing that is not the same for the two faces (neglecting any question of direct ether pressure) is the geometrical distance between the vane surface and the bulb surface.”

Only on one occasion did Thompson have the pleasure of receiving Lord Kelvin in his own home at Hampstead.

It was rather too far off for an evening visit, with all Kelvin's numerous engagements ; but he and Lady Kelvin were able to attend an afternoon reception, which Thompson had arranged in order to introduce his friend M. Henri Becquerel of Paris to some of the members of the Physical Society, and there was a numerous gathering of scientific worthies, whom Kelvin enjoyed meeting.

It was not until Kelvin had passed the four-score years that Thompson began to entertain the idea of writing a biography of him.

The great success and appreciation with which his *Life of Faraday* had met led him to believe that he could make a similar success with a biography of one even more renowned in the scientific world.

In March 1906 he summoned up courage to approach Lord Kelvin, then living in London, on the subject, sending him at the same time a copy of his *Life of Faraday*.

The following was the reply he received :

“DEAR THOMPSON,

“Three days ago I received your beautiful book on Michael Faraday, and I have been reading it with great interest and much pleasure. It gives, I believe, a thoroughly truthful view of his scientific work and of his life. As you kindly told me you had been thinking it possible you might wish to undertake writing an account of my own scientific work, I can say that I would feel complete confidence that in your hands it would experience thoroughly satisfactory treatment. If you are inclined to talk over the matter just now, shall we meet one of these days, at any time that would suit you—either morning or about tea-time after the working day is over ?

“Yours always truly,

“KELVIN.”

Soon after this it was agreed between Kelvin and Thompson that the latter should come and have interviews with him, and talk about the scientific work done in the early days at Cambridge and Glasgow.

During the spring of 1906 Thompson had several of these “sittings,” as he called them, and afterwards made

voluminous notes of the grand old man's reminiscences. Then, when the London season was over, Kelvin went to his home at Largs, and it was not until late in October that they were able to meet again. Kelvin wrote to Thompson on October 18th from Largs, in answer to him :

"Many thanks for your letter. I was glad to receive it yesterday. I do not think my Siphon Recorder can help in respect to wireless telegraphy. An ordinary relay is more suitable. The only merit of my Siphon Recorder would be to work with a less strong current. Its merit for submarine telegraphy is that it indicates continuously varying strength of current ; and this is not wanted in wireless telegraphy.

"We are going to London on Tuesday next for the, Autumn Session. I do not know how long we may be kept, but I shall hope to see you before we leave, and to talk over Helmholtz and Clausius and some other interesting subjects."

So a few more sittings took place in the autumn, and again in the spring and early summer of the following year.

In Thompson's note-book for 1907 many entries headed "Kelviniana" are to be found, and he had begun to plan his book, which was intended to be in one volume, and was to be published by Messrs. Macmillan. The titles of the nine chapters of which it was to consist were outlined, and a list made of the plates which were to illustrate it.

He used to put down lists of the names of persons from whom reminiscences of Kelvin might be got. Some of these, when acquired, were very characteristic of the man. For instance, Sir William Crookes told how, when Kelvin first saw his radiometer, he sat in silence gazing at it for an hour. Another story was of a meeting of the British Association, at which Crookes had read a paper in Section A, Sir William Thomson presiding. Various remarks had been made, and then the next business was taken. "On the same evening Crookes met Sir William at dinner. "Oh," he said, "oh, Mr. Crookes, I wish you had been in the Section to-day : there was such a beautiful paper read. It would have interested you so much. I looked all round the room for you, but I couldn't see you anywhere!" (Crookes had been on the platform beside him.)

At the British Association at Leicester in 1907, when Thompson was presiding in the Engineering Section, he again saw a good deal of Lord Kelvin, who, despite his age and his indifferent health, was entering with surprising activity into the discussions.

But this was the last occasion on which they met. After the Kelvins had returned to Largs in the autumn, Lady Kelvin was struck down with a paralytic seizure, from which she only partially recovered. The shock of this sudden illness of his wife, and anxiety about her, were too much for the aged Lord Kelvin, who fell ill and died in December.

He was buried in Westminster Abbey, and an immense concourse of scientific men was present. Delegates from Societies and Institutions followed the coffin in procession, and among these Thompson represented, by special request, the *Associazione Elettrotecnica Italiana*, of which he was a member.

For a long time—about six months—it was very difficult for Thompson to make much progress with his biography. Owing to Lady Kelvin's state of health, he could not obtain permission to borrow papers and letters which were necessary to his work. In January of 1908 he was in correspondence with Dr. J. T. Bottomley, nephew of Lord Kelvin. There seems to have been a desire expressed by the family that Thompson's book should be the official biography of Kelvin.

In answer to an enquiry from Dr. Bottomley about the scope of his proposed book, he wrote as follows :

“ The plan which was adopted from the first was a one-volume book, and there was no intention, if it should have been published in Lord Kelvin's life-time, of printing in it any considerable number of letters. Nor was it the intention to give any deeply scientific analysis of Lord Kelvin's papers, as it was to be suited to non-mathematical readers. The very last time I saw him, he told me he had himself been setting down some further notes for me.”

The decision that the book was to be a full biography of Kelvin threw on Thompson a heavy responsibility and a most difficult task, which occupied all his spare time and most of his holidays for the next two years. Of course,

much other work and writing had to be laid aside until its completion.

His friend Mr. M. F. O'Reilly (Brother Potamian) wrote him in January 1908 from Manhattan College :

"We have lost our Mentor : our great instructor, who instructed as much by his noble example as a Christian gentleman as he did by his writings, lectures, and discourses. I was glad to learn that you will do for Lord Kelvin (I prefer the plain name) what you have so beautifully done for Faraday. My wonder is how you get time to accomplish so much."

For several months Thompson struggled with the difficulties of finding out the facts of Kelvin's early life and work from the few surviving contemporaries whom he was able to trace. At last an application to the Registrar of St. Peter's College, Cambridge, for some information was by him passed on to one of the Fellows of the College, Mr. J. D. Hamilton Dickson, who was an old pupil of Lord Kelvin's. This was a most fortunate occurrence for Thompson, for Mr. Hamilton Dickson was a most enthusiastic admirer of Kelvin, in fact regarded him with something amounting to hero-worship. He replied to Thompson's enquiry in the most kind and friendly manner, and offered to do anything he could to help him in his great undertaking.

Thompson was delighted, and used to pour out questions relating to all sorts of events which occurred in Kelvin's student days in Cambridge. His first letter to Mr. Hamilton Dickson was written in June 1908 :

"DEAR SIR,

"From your exceedingly kind note on the postcard, I infer that you conjectured that my enquiry about Professor Fuller was connected with my biography of Kelvin. This is so. I am much obliged for the reference. But I am much more indebted to you for the additional information as to the testimonials which he sent to Glasgow in 1846.

"This is indeed a 'find' for me. I shall be most grateful for the sight of the copy of the testimonials, which shall be returned at the earliest opportunity. With many thanks for your kindness."

During the early summer Thompson paid visits to Glasgow and to Newcastle to see the nephews of Lord Kelvin, and to try to gather up all kinds of information about his family and friends.

He overworked very much at that time, and was ordered to take a long holiday during the vacation. He had perforce to obey, and went for six weeks to Switzerland with his wife and family, living among the high Alps at Axalp and Stein in the Oberland, and devoting his time to botanical rambles and water-colour sketching.

He returned to London refreshed, and wrote to Mr. Hamilton Dickson on September 8th :

“ If, as is probable, this letter will find you away from Cambridge, please do not attempt to answer it until you return. I write while I have the leisure, for with the end of September comes the [Administrative] deluge upon me. First I wish to tell you that I have definitely identified the ‘ Field ’ whom Lord Kelvin mentioned as a member of the ‘ Fleet.’ He was the Rev. Thomas Field, of St. John’s, who took the Classical Tripos in 1844, and was for many years Tutor at John’s.”

Then follow about a dozen questions about matters which could only be found out by hunting up registers at Cambridge. Mr. Dickson was untiring in his help, and unsparing in his devotion to the small details of information which Thompson required in order to picture the surroundings of his hero’s college life.

He wrote again on September 17th :

“ Again you have laid me under obligations, and things are becoming clearer. But there are some outstanding points.”

Then follows another string of questions about the Cambridge British Association Meeting of 1845.

In January 1909 he writes :

“ I have your list of Lord Kelvin’s distinctions—it is considerably fuller than mine, but I think I can add one or two entries. Pray let me keep it a few days to verify the

list point by point—or rather, to check it against mine. Thanks also for information about rooms in Peterhouse.

“I take the opportunity to offer you a literary trifle that may interest you.”

Mr. Hamilton Dickson replied :

“I cannot rest till I thank you for your kind letter and its two enclosures. I know I shall enjoy reading both—Petrus for his own sake, and the pamphlet on Petrus for the sake of its writer ; for is it not well known that its writer is the most learned on all that deals *de magnete* ? Thank you again heartily.”

A few days later he wrote again :

“Your *Petrus de Magnete* is very interesting—both the lovely little bookie (rubricated by S. P. T.) and your capital monograph on it and him. I have read the most of the monograph, but not so much of the Petrus : however, that is a treat to come.”

As the months went on their correspondence became more and more frequent, and to save time they began to imitate Thomson and Tait's manner of addressing one another, and wrote “O. T.” or “O. D.,” ending up with the word “Salaams,” of which Thompson wrote :

“This convenient orientalism saves a lot of rigmarole of ‘Kind regards’ and ‘believe-mes,’ and for the friends to whom I address it means far more than such conventionalities mean to Tom, Dick, Harry, Brown, Jones, and Robinson. *Non ragionar di lor.*”

In July Thompson visited Cambridge, and gathered much information. His letter to Mr. Hamilton Dickson after his return must be quoted :

“I had a curious journey back from Cambridge on Monday evening. Alone, most way in the ‘compartment. I was trying to read proofs, and to piece together, and carve on memory, the hundred and one things that you had told me. And all the while I was haunted by an idea that I couldn't throw off, and that recurs each day since, that

you, and not I, ought to be writing this biography of the wonderful old man. You, who knew him at far more close quarters than I. You, who knew Glasgow, and the old College, and White's, and the development of the recorder, and the Lalla Rookh; and who knew Cambridge at first hand, and for so many years in the very spot that knew him. And yet it is I, and not you, who is to be supposed to know all about him. I shall *have* to send you, when they are complete, the proofs of the parts that relate to Cambridge, and to the Laboratory corps. I tremble at the crop of innocent blunders that lie there awaiting the blue pencil of the master who knows (*maestro di coloro chi sanno* !)

In January Thompson sought help from Professor Kennelly of Harvard :

"Your kind greetings for the New Year duly arrived. Mrs. Thompson bids me to add her acknowledgements to Mrs. Kennelly and yourself. We sent out no cards this winter, for my mother-in-law Mrs. Henderson, who has lived with us for many years, died just at the end of November, and with this upset, and the great pressure on me in trying to complete the Kelvin biography, I had no time to design a greeting to send to our friends.

"I find myself in a difficulty as regards some of the American honours of which Lord Kelvin was recipient. So, wanting to make the list as complete as possible, I venture to trouble you with the enquiry whether you can help me to complete the list. I believe Lord Kelvin received several hon. degrees in 1902, his last visit to the States. Did not Harvard give him an honorary degree ? "

At the end of July 1909 Thompson wrote to Sir William Crookes, whose portrait had just been painted for the Royal Society by Mr. E. A. Walton, R.S.A., brother-in-law of Thompson :

•
"DEAR SIR WILLIAM,

"May I reply quite briefly ? Your letter does not say what hour you are leaving for Sark. I am going down to Wenhaston for my holiday next Tuesday, and shall see Edward Walton that evening : the house we have taken being next door to his. So I will find out what he wishes. But if you leave for Sark before a letter can reach you, then

I think it will be all right if the portrait is left locked up as you suggest. I have been wanting—much wanting—to come over to see you and the portrait. But for three weeks past I have simply abandoned every other engagement whatever, to stick to the writing of the last chapters of my *Life of Lord Kelvin*. It was my only chance of getting the thing done this summer. And even now I shall have to finish two of the chapters at Wenhaston.

“It takes a weary time to write the connective tissue, even after all the events and principal paragraphs are completed in themselves. Nothing but a steady grind, with all reference books and entries round one, will enable one to do this. So I have been a hermit for the last three months (partially) and totally since July 8th. But for this I would have certainly dropped in. About one-third of the book is in type already.”

From St. Michael's, Wenhaston, August 11th, he wrote to Mr. Bailey Saunders :

“I believe this is the correct date—but one loses count of time in the lazy days of a real summer, and in rural seclusion, even though one has one's work with one, as I have with my Kelvin biography, on the last tenth of which I am still perforce at work. My immediate purpose in writing is to draw upon your long-suffering friendship for a reference that here is totally inaccessible. You are a Hegel scholar, though I fancy not a Hegelite—at least, not a bald-headed one. But you probably know where to find in his philosophy a passage in which he attacks Newton's theory of planetary movement, according to universal gravitation, and says something about *the planets not being pulled this way or that way like so many stones, but that they move of themselves in their orbits like the blessed gods*. I want the passage itself (either in German or English) and the reference to page and volume. It used to rouse Lord Kelvin to a white heat of fury. ‘If these, gentlemen, be his physics, what must his metaphysics be?’

“And how does your *opus magnum* progress? You used to say mine would be out before yours. I can't by any possibility be out before November: and the printers are going very slowly.”

Mr. Bailey Saunders replied from the Athenæum :

"Your letter reaches me here on my way back to Eastbourne on Monday.

"I wish I had any claim to be a real Hegel scholar, and were then enabled to answer your question. The only work of his which I have read—many years ago—was the *Phäsomenologie der Geiste* (I am not sure that I have even got the title right), and I cannot recollect anything about Newton therein, though I have heard of Kelvin's famous dictum on Hegel's physics. Nor can I find any one to help me to the utterance of that philosopher, whose works I should doubtless seek in vain in the library here. I have, in fact, just been to look for his name in the Catalogue, where of course it is emphatically not.

"You will get out the biography in November; my *opus* will appear when? *das weiss der kuk-kuk!*

"If you like hot weather, you must be as jubilant now as I am depressed. Please remember me very kindly to the verehrte Frau Professor.

"P.S.—Thanks for the Melanchthon letter references. I will look it up in the Corpus Reformatorum."

Thompson, in another letter to Mr. Bailey Saunders on September 21st, writes from home:

"I am still labouring at the two remaining chapters of *Kelvin*—pure plod—dates, facts, letters, but not a bit of science or philosophy in them, needed to complete the tale.

"Volume I. is paged up and indexed, Volume II. is four-fifths in type, and partly paged. I want three weeks of uninterrupted time—but doubt whether I shall have so many days without distractions. We are all well. Come and see us when you are in town. Salaams."

Thompson, in fact, had accomplished an enormous amount of work on the book during the six weeks at Wenhaston, but at the expense of needed rest of brain, and exercise. Proofs were pouring in all the time, and during the glorious weather of that summer he spent hours at a time sitting out on the lawn correcting them. The daughters and nephews and nieces found it difficult to persuade him to join any of their excursions or picnics.

He went one expedition quite willingly, and that was to meet Mr. Hamilton Dickson, who was staying a few miles

away near Dunwich, and he, later, kindly came over to Wenhamston, so that they were able to consult verbally over many difficult points. Mrs. Thompson's services were also requisitioned to do the indexing.

One of those who had known Kelvin for many years was Sir Joseph Swan, and Thompson had some correspondence with him while at Wenhamston. On September 9th he wrote :

"DEAR SIR JOSEPH,

"Your long and interesting letter puts me deeply into your debt. I presume I am at liberty to use it in my biography. I return the letter about Varley : it is the more interesting, because Varley (this Varley—Samuel Alfred, not Cromwell—) had attacked him in 1888-9 in *The Electrical Review*."

With Professor Chrystal, the Astronomer Royal for Scotland, he had also considerable correspondence about the publication of his letters to Kelvin. Writing to Thompson, Professor Chrystal said :

"I must not neglect to congratulate you on the approaching completion of your book. You seem to enjoy a happy share of the great energy that to the very last characterised your great namesake without a 'p'."

It happened once or twice during Thompson's career, that he was confounded with his great namesake. The first time was when he was Vice-President of the Frankfort Exhibition, when the portrait of Sir William Thomson was displayed in the German newspapers as that of Professor Silvanus Thompson. Sometimes, too, he was supposed to be his son.

In October Thompson sent portions of his book in proof sheets to various people for correction and criticism before finally finishing it for the press. The difficult chapter on "Thermodynamics" was, among others, submitted to Sir Oliver Lodge, who wrote :

"DEAR SILVANUS,

"Thank you for sending me Chapter XXIII of your book. I have read it (rather hastily it is true, in the train)

with considerable admiration for the way you have treated a most complicated affair. The essential feature is that he started with dynamical determination, and found that it led him into a *cul-de-sac*.

"Whether posterity will take the same view it is not for me to say, but that it appears thus to us is, I think, sufficiently and fairly brought out in your chapter; and that is what, it seems to me, ought to be brought out—of course in an entirely complimentary manner."

He then went on to make various small and helpful criticisms on the chapter, closing with the remarks:

"It seems to me thoroughly good for its purpose, and, though long, not dull. Posterity will be grateful to you, even if the present-day public are not.

"I would not attempt to shorten it. Length is part of the essence of the Kelvin prolificness."

Sir George H. Darwin, of Cambridge, wrote:

"I have read the portion of the *Life* with interest. I entirely agree with you in the omission of certain passages. I think you will make the *Life* a success. It is an arduous undertaking."

Thompson's volume did not issue from the publishers until January 1910. The book had been eagerly expected by Kelvin's many admirers, and from a host of them it received a most flattering and warm reception.

Scores of letters from scientific men were sent to the author. Many of them ranked the biography with the best biographies of modern times. Professor Perry considered it as good as Trevelyan's *Life of Macaulay*, others compared it with Morley's *Gladstone*. Thompson's old friend Sir William Preece, F.R.S., wrote in March 1910:

"I have been through your *Life of Kelvin* with great care, and with infinite pleasure. It reflects the very highest credit on your labour, your skill, and the marvellous gift you have of picking the plums out of the pudding, and dressing them with tasty sauce and ornamenting them with clear, bold English. I found it most interesting, for I knew him in his Atlantic days, and we were always on very intimate and

friendly relations. I am proud to have commenced my own career under the powerful influence of Faraday, and to end it under the ægis of Kelvin, for I am now nearly played out. I am now in my seventy-seventh year. Your proofs have been very carefully read, for I have come across extremely few errors. Doubtless you will soon have a second edition, and I send the few points I have noted. There is nothing I admire in your book more than your handling so many intricate questions, without the aid of his own language."

The criticism of the book in the press was extremely favourable, though in many papers its scientific basis was a stumbling-block to the reviewers, who contented themselves with picking out various tit-bits of lighter vein, and leaving serious discussion of the work to more technical journals.

Sir Oliver Lodge reviewed it in *The World*. He wrote :

"An extremely difficult duty was committed to Professor Silvanus Thompson when he undertook to produce a popular and readable *Life of Lord Kelvin*, and admirably has he executed the task. I cannot see how any one could have done it better.

"Lord Kelvin has been fortunate in his biographers. . . . Now the main incidents of his life, and the general tenor of his thought and work, have been narrated with consummate industry and skill by the present author."

The Outlook said :

"This work is a distinguished *savant's* biography of one greater than himself ; a book therefore primarily for men of science, largely made up of letters and discussions dealing with matters that to the general reader are much more hopelessly incomprehensible than Greek. But there is throughout it abundant humanity and the fascination of a transcendent mortal life ; nor would we leave the impression that the volumes are without a strong salt of the gaiety that goes with high activities."

The Saturday Review said :

"Professor Thompson has treated the two phases of Kelvin's life as few men would be competent to do, and

with equal skill. He has combined the refractory elements into a narrative which, for all its bulk, its immense range of time and material, and its multifariousness of topics, is not only smooth and literary, but more—artistic and vivid. Professor Thompson has given us a real and great biography; and, though Lord Kelvin's work required so much dry, technical description, his personality pervades everything in the book, and shines brilliantly through it."

In 1911 Thompson received a letter from Mr. Sidney Lee, editor of *The Dictionary of National Biography*, in which he wrote :

"Would you render the *Dictionary* the great service of contributing the memoir of Lord Kelvin ?

"Your full biography is the standard authority for his life, and it is only right that the summary account which we need should be from your pen. I trust you may see your way to accept this proposal."

Thompson wrote the article as requested; it was not the only one which he contributed to the *Dictionary*.

CHAPTER XIV

HOBBIES AND HOLIDAYS

"I have indeed lived nominally fifty years, but deduct out of them the hours I have lived to other people, and not to myself, and you will find me still a young fellow. For *that* is the only true Time, which a man can properly call his own, that which he has all to himself; the rest, though in some sense he may be said to live it, is other people's time, not his."—ELIA; *Extract copied in the "little blue note-book" for 1911.*

FROM his earliest years Thompson had acquired the botanical bent of his family. Of butterfly and bird he never made a special study, and had no claims to be considered an all-round naturalist; but in the Yorkshire dales he became thoroughly at home with the British Flora, and, as school-children, he and his brothers and sisters knew every haunt of the rarer plants within a considerable radius of Settle. They were familiar, too, with the many fascinating geological phenomena that are characteristic of the region of the great Craven Fault, where the Mountain Limestone presents curious structural and stratigraphical features, with its dry valleys, its tarns and becks, its waterfalls and underground "churns," its Ebbing and Flowing Well, its extensive caves and "horrid chasms" like "Gaping Gill" and "Alum Pot."

In the summer of 1890 Thompson with his wife and small girls spent the holiday with his sisters at Settle and he once more explored the old haunts. That year he identified in a new locality *Arenaria Gothica Fries*, a species his sister Rachel had earlier discovered close to Ribbles Head Station. Dozens of collectors were reported as having come in search of the rarity that year, and there were fears lest it should meet with extinction. But in 1905 Thompson went again, accompanied by his daughters Helen

and Dorothea, to seek the little white flower, guided by the entries on the family maps, and found it still extant.

In 1890 Professor Meldola and his wife also spent their holiday in Settle, seeking moths, so there were joint excursions of the colleagues. Thompson determined if possible to solve one of the local mysteries, namely the course of the stream which flows out of Malham Tarn (one of the largest sheets of enclosed water in Yorkshire), and, after pursuing its way over the moors for about half a mile with slight gradient, suddenly sinks into stony ground and disappears. A dry valley, once a considerable watercourse, leads on downwards about a mile, and then ends abruptly at the top of Malham Cove, a limestone cliff over 300 feet in height, from the foot of which issues a stream about equal in bulk to the Tarn waters, but popularly believed to come from some other source, the Tarn waters being supposed to issue at "Airehead," a perennial spring in the middle of a green field about a mile below the Cove.

He sent a paper to the Geological Section of the British Association that year, in which he described the experiment he had made "On the Sources of the River Aire." Professor Meldola had suggested to him that he should use uranin, the soluble form of the dye fluorescein, of which a minute quantity colours without polluting the water. Thompson made satisfactory tests with this in a simple case of a known underground course of a stream, but when he set watchers at the two suspected issues of water at Malham Cove and Airehead, and sent his dye stuff down the sink-hole, he obtained no results. The Association Meeting was sufficiently interested to appoint a committee to investigate the matter, Thompson being secretary; but, on applying to the owner of the Tarn, they were informed that investigations had already been made by Bradford naturalists, who, on allowing a sudden rush of water out of the Tarn, saw an increase in flow at Airehead about eighty minutes later, and not till about an hour after did it show at the Cove, pointing to complicated passages and lakes in the subterranean connections.

In 1905 Thompson rambled over the old district delightedly

pointing out its peculiarities to the younger generation, with whom he discussed the possibilities of investigating, on strictly scientific lines, the ebb and flow of the famous well near Settle.

Elsewhere such interests added zest to his excursions on which he always sought company, and was only rarely and accidentally alone.

From a letter to his wife :

“THURINGENWALD,
“April 1900.

“This is Sunday. . . . After breakfast I started southwards up the forest road—a mere mule-track—to a *Forsthaus* on the ridge above. . . . I reached the pine woods, carpeted at every clearing with undergrowth of hepaticas—the ground was just blue with them in places, like the primroses in the clearings of our woods, only blue instead of yellow. In a few places they grew pink instead of blue. Also I noticed a blue rush which I should have called, *Luzula cerulea*, if there is such a plant. Then in the forest clumps of the delicious *Daphne Mezereon*, and here and there a yellow flowering tree that I have never seen before ; I think it must be a sort of *Rhamnus*.

“After I had walked about an hour amongst the pines and oaks at the top, I came on a patch of the most glorious purple anemones—the *Anæmone pulsatilla*. I enclose a couple of them. They are indescribably beautiful as seen in mass. They are said to grow occasionally in England.

“I had a fine round on the high ground. It resembles the Schwarzwald a good deal, and particularly in having everywhere excellent *Wegweisers* to show the routes.

“The geological formation is curious. At first I thought it oolite ; but in places there is red marl with satin-spar among it. I think it must belong to the Keuper beds.

“The girls would have gone just wild over the beds of blue hepaticas. At any rate their *pa* did !”.

A few years later Thompson spent a week of his Easter holiday in the New Forest, exploring on foot in company with his daughter Dorothea. In one of the clearings they came upon a whole bed of a small flowering shrub, which he could not place at all, and which was identified by the authorities at Kew as an American species sometimes grown

in gardens, but never recorded before as a wild plant, and not easily accounted for in the middle of the forest.

Part of the joy of the holidays in Switzerland arose from the glory of the flowers of the Alps, though in August it was only on the heights well above the tree-line that these beloved blue gentians could be found, and more than once the season had been so advanced that there remained none of the rich red of the Alpenrose for foregrounds to sketches. The family had a particularly happy time with flowers in 1907, when they got away early in July to Axalp, above Lake Brienz, where the snows were longer than usual in retreating, so that the full glory of unmown alpine hay-fields was theirs to enjoy, until Thompson was due back at the British Association. On returning again next year to the same place, half the charm had gone with the flowers, and it was only at the higher levels that Thompson was tempted to sketch on the few fine days during that wet August. Some thousand feet above the hotel, and above the steep tree-clad slope, stretched gradually ascending alps to the foot of a great range of cliffs. An immense fall of rock had, perhaps some forty years earlier, strewn many acres of the alp with a belt of stony fragments that created a perfect garden, with damp sheltered nooks and warm dry banks. Fir-trees perched themselves in all manner of unexpected ledges and crannies, and rich patches of Alpenrose lent the warm tinge needed to relieve the cold colouring of the green and the grey. Hither one fine morning came Thompson armed with his boards and palette, and Dorothea with a volume of poems. There they spent a whole day, one always memorable; for he came down in the evening carrying no less than three sketches of the stone-fall, perhaps the most living of all his tree pictures, and with his memory stored with the music of Keats's "Ode on a Grecian Urn," which Dorothea had been reading over to him while he painted.

All through his life Thompson associated with people of the same bent as himself. In early days he was a member of the Bristol Naturalist Society, and after his removal to London he became connected with the Hampstead Scientific

Society, of which he was a vice-president and president, though he was not often present at its meetings, which were held the same night in the week as the members' meetings at the Royal Institution.

Through Professor Meldola he was introduced to the Essex Field Club, in whose autumn ramble and fungus foray in Epping Forest he occasionally joined, taking with him his youngest daughter Irene, who was the keenest naturalist of the four, and who acquired considerable skill in representing her plants, fossils, and insect pets in water-colour sketches.

In 1907 Thompson was President of the South-Eastern Union of Scientific Societies, which linked together some sixty local groups of naturalists and archæologists of seven counties. His predecessor in office was Sir Francis Darwin, and he was succeeded by Sir Archibald Geikie, the ex-President of the Royal Society. His presidential address throws much light upon his manner of thought outside the prescribed circle of his daily avocations and duties in the field of science. He took, as the foundation of his theme, Pliny's dictum, "*Ne sutor supra crepidam judicaret*," which has passed into the English proverb, "Let the cobbler stick to his last"; and also the English poet's fallacious sentiment :

"A little learning is a dangerous thing;
Drink deep, or taste not, the Pierian spring."

He ardently defended the amateur in an amusing imaginary conversation with his "friend Supracrepidarius," and produced evidence from "the achievements of the supracrepidarians—the cobblers who have become immortal by not sticking to their lasts: Herbert Spencer, who left engineering to create a synthetic philosophy; Keats, who left surgery to write the 'imperishable odes'; the curate of Selborne; Thomas Hodgkin, the banker, one of the greatest historians of his day." His particular interest in the literary men who cultivated scientific studies led him on to dilate upon the works of Tennyson and Goethe; but at the end he turned to another aspect of non-pro-

fessional science : the zest it gives to life and particularly to travel :

“ There is, perhaps, nothing that contributes more to the enjoyment of travel at home or abroad than a little knowledge of botany, geology, and entomology, particularly botany. Abroad one watches with the keen delight of novelty the unfamiliar plants and the strange and beautiful flowers. One’s first sight of the fields of narcissi in the pastures around Lausanne and Vevey—familiar as the *Narcissus* is to us as a garden plant—is almost as exhilarating as the first glimpse of the *Soldanella* rearing its tiny bells through the melting snows of the higher alps. You know the story of the great Linnæus, how he fell on his knees in ecstasy before the golden gorse-bushes on Wandsworth Common. One begins to understand the feelings of Linnæus when, travelling in Norway, one first finds the exquisite trails of the *Linnæa borealis* peeping through the mosses under the pine-trees. Travelling in Canada, it is a peculiar joy to discover for one’s self that, in all the neglected corners and roadsides where one would expect untidy clumps of golden ragwort, their place is taken by masses—no less untidy in truth—of Michaelmas daisies ; the purple *Aster* replacing the yellow *Senecio*. At home the memories of old rambles revive in every nook one revisits. Crossing Yorkshire less than a week ago, I found such recollections crowding in upon me. There, as the train flew by, was the identical bog where, as a schoolboy, I used to find the rare *Lastræa thelypteris*. . . . A mile or two further on I catch a glimpse of the sandy field beneath the fir-tree where for several successive years I found the almost extinct *Veronica triphyllos*. Back there comes the memory of a sunny Good Friday afternoon when I hunted that field and counted no fewer than eleven specimens ; and I am filled with a glow of conscious self-righteousness, of which I am not ashamed, when I remember that I took but three of these, hoping the remaining eight would fructify and yield a good crop next year . . . and I think of the field of marshy hillocks, ten miles further north, where as a boy I used to gather Lilliputian nosegays of *Primula farinosa*, the fairy flower, and where, later in the year, one could find orchises, epipactis, yellow woad, and curling fronds of moonwort. Alas, that fairyland is fairyland no longer. They have turned it into golf-links—have smoothed out flat teeing

grounds, and disfigured it with silly bunkers. The fairies dance there no more, the birdseye primrose has disappeared, the orchises and epipactises have been exterminated, and the moonwort is as extinct as the dodo. Up the valley, a few miles to the north-east, I see the line of crags where the holly-fern used to grow. It grows there no longer, thanks to the greed of the fern-hunters, and, across the valley, almost in the shadow of Ingleborough, lie the spots—wild horses would not drag from me the secret of their situation—where twelve [?] years ago I found in unquestionably wild state the little *Arenaria gothica*; the only specimen of it from British soil ever before recorded having come from the doubtful habitat of a railway-yard. . . . The happy day spent in the field or the forest amongst the birds and insects, or in the quarry with the hammer, writes its own record on the tissue of the brain. And, as with the phonograph, one may take out some cylinder long ago inscribed, and place it on the instrument, and listen anew to the voices of those who, it may be, have passed into the silence beyond, so may we bring out the records of our happy field-days, and live them anew, while the sunshine and the bird-songs, and the hum of the bees and the sound of the wind in the pines are ours once more, and the things of beauty have become joys for ever.”

He made two practical suggestions to the Union, one relating to the co-ordination of the local and partial surveys of different regions, in which the amateur might happily play his part, and the second—what the Selborne Society (of which he was Vice-President) has done for the protection of wild-birds might surely be repeated for our wild-flowers before it is too late :

“The bee-orchis is growing scarcer year by year on the Surrey hills, though even on Box Hill it is still found. The fritillary still rears its snaky head in the Thames Valley, though every year the rapacity and thoughtlessness of man is thinning it out. . . . We sorely need the public to be indoctrinated with the wholesome view that a wild-flower is the property of the community, to be enjoyed by all, and therefore not to be selfishly grabbed or rooted up. . . . What England owes to the voluntary workers in science no man can declare or measure. . . . It is a work of national importance which [the societies] are carrying on in

spreading the scientific culture and in fostering influences which correct the bias of industrial and commercial careers, and broaden out the narrownesses of our educational system.

"Yes, England has need of those whose scientific work is done for love and not for money; of those who recognise that in the intellectual sphere also it is everlastingly true that a man's life consisteth not in the abundance of the things he possesseth."

Thompson possessed many things, but he did not collect any of the usual things pursued by the naturalist: books, prints, and autographs descended to him from the older generation, and he added much to these collections; but he began and gathered for himself a small and very lovely little selection of uncommon precious stones, many of which he valued for their optical properties, others for their sheer beauty of colour and brilliance when properly cut.

An intimate friend of Thompson once remarked about him that "for him a holiday was merely freedom from routine work, and a change of scene to begin some long-cherished project." No one was more industrious on holidays than he, and during many summers he added considerably to his collection of water-colour sketches of Alpine scenery or of some favourite haunt nearer home. As years passed on he became more and more devoted to drawing and sketching among mountain scenery, either in Scotland, Switzerland, or the Tyrol.

In 1883, after his visit to Germany to hunt up details for his *Life of Philip Reis*, he and his wife went on into Switzerland, and spent three delightful weeks in the Oberland, where he made his first really successful sketches of glaciers and snow-peaks, though in those days he did not attempt to work on a large scale. For some time they stayed at a small hotel on the pass from Meiringen to Grindelwald, where were gathered together some six or eight artists of considerable note, among them Sir Robert Collier (afterwards Lord Monckswell), Colin B. Philip, Walter Severn, then President of the Dudley Gallery, and the President of the Swiss Academy, who was a wonderful colourist.

Talking with these men and watching their way of work-

ing, Thompson learned much, and some of his sketches of the Rosenlauri Glacier and the peaks of the Wetterhorn were exhibited in the Dudley Gallery in London in 1884.

During the next nine years he had no opportunity of working at his favourite ice subjects, except when he sketched from the deck of an Atlantic Liner an iceberg which he saw in the Straits of Belle Isle. But during those years he did some very good work in Scotland at Glen Sannox, and on the Yorkshire coast.

In 1889, after the death of their mother in the spring, the Thompson brothers and sisters nearly all met together at Sandend near Whitby, where Silvanus and his brother-in-law, Ellwood Brockbank, had taken houses for the summer months. That year he painted dozens of studies of sea and sky effects, and gained greatly increased facility. So much so that, when he went to Italy in 1892, although most of his time was taken up with sight-seeing on first visits to Florence, Rome and Venice, yet he was able to make some most effective sketches in odd moments. The holiday in Italy lasted six weeks. Thompson and his wife joined her father and mother and two younger sisters, who had made the tour before. In Pisa he made a sketch of the wonderful group of Campanile, Baptistry and Cathedral, which was exquisite in delicate drawing and colouring. In Rome he stole a few hours from visiting churches, and painted two sketches, one in the English cemetery, of the graves of Keats, Severn and John Bell, and another just outside the walls. In Southern Italy, where the party spent Easter at Amalfi, he revelled in the glorious colouring, and loved to get studies of olive-trees against the background of Mediterranean blue. He succeeded in making three vivid pictures. Assisi also proved a happy sketching ground, for the sun shone brilliantly, and several days were devoted to recording in colour views in that historical city. One of the few days devoted to Venice was spent in going by gondola to Torcello. Thompson sketched the fairy-like sail-boats as they crossed the Lagoon, and at Torcello made a study of the ivory-tinted marbles of the courtyard and fountain with the Cathedral in the background.

Most of the Italian sketches had to be left unfinished. On his revisiting the same scenes in the spring of 1912 the weather was cold and showery, and no sketching could be done.

In 1894 began the first of a long series of holidays in the Alps, in which his sister Rachel and the young daughters began to share. At Riffel Alp that year he attempted work on a much larger scale, and his pictures of the Matterhorn in storm or sunshine, and studies of the Findelen and Gorner Glaciers, were some of the best work he ever did.

He was now a member of the Royal Water Colour Society Art Club, which included many professional artists, among them David Murray, Colin B. Philip and Wilfrid Ball. The club held an exhibition every autumn, to which Thompson frequently contributed the results of his summer sketching in the Black Forest, Evolena Valley, Arolla heights, and Northern Tyrol.

In later years some of his many friends, who were members of the Alpine Club, and whom he used to meet in Switzerland, invited him to exhibit at their winter show in the hall of the Club, and there his work was seen at its best. In 1910 he did some very fine glacier painting at Saas Fée, and Macugnaga, where he first began to go with a guide among the crevasses and seracs, returning after a long day on the ice with one or two rapid sketches of its wonders and glories.

The summer of 1911 was very fine and hot, and he and his wife and Helen went for a month to the Chamonix Valley. Here he produced as much work as many a professional artist accomplishes in a whole season. While staying for three weeks at Hotel Planet above Argentière, he made the acquaintance of an English artist, Mr. George Flemwell, who was spending the season there, painting flowers for a botanical book, which he was producing in conjunction with Mr. H. S. Thompson, a botanist, who was also living at Le Planet.

Thompson and Flemwell soon found that they had much in common, and used to have long discussions over botany and painting, and made excursions together. Afterwards they kept up a correspondence, but never succeeded in meeting again in the Alps. In the autumn of that year

Thompson had six large pictures in the Alpine club show, two painted on the Glacier des Bossons at Chamonix, three on the Glacier d'Argentière and one of "Twilight on Mont Blanc, from Le Planet."

In August 1912 Thompson wrote to Flemwell from Strathyre, Perthshire.

"We shall not see Switzerland this year; for my wife claimed her privilege as a Scotswoman to have this year's vacation in her native country.

"I love Scotland; but I love Switzerland more, and I am wearying for a sight of real peaks, and for ice.

"The braes and banks of Balquhiddy are all very well, and the heather is lovely—when the sun shines on it. But that is precisely what the sun is not doing this year. Dull days and everlasting drizzle is our fate so far: and when a fitful episode of sunshine occurs, it is a miserable, washed-out sun with no warmth and no persistency. Here's more than a whole week of my short holiday gone: and I have not put a paint-brush to paper.

"The Scotch hotel-keepers declare that Scotland is almost empty. They don't blame Switzerland: they say it is all along of Mr. Lloyd George, and the strikes and the industrial unrest!

"I came across a lovely patch, in a garden here, of a most lovely white variety of *Epilobium Angustifolium*. Have you ever seen it wild? I bethought me of that pink patch above Les Tines. That reminds me that, just before leaving home, I got Mr. Stuart Thompson's book with your plates of flowers. They are lovely, but are you right about St. Bruno's Lily? I thought it was smaller.¹ Is not the one you have drawn the Paradise Lily? Your white Alpenrose (*Rhododendron*) is just exquisite. More power to your elbow."

Next year, 1913, Thompson returned again to Argentière, after first spending a fortnight at Zinal, which was fruitful in achievement. Mr. Flemwell sent him a letter welcoming him back "to Switzerland, her seracs and her ice-falls!" but was not able to come himself into the High Alps that summer. Dorothea, the third daughter, accompanied her father and mother this time; but she was not well, and

¹ Mr. Flemwell was quite right.



A NATURAL ICE-ARCH ON THE GLACIER D'ARGENTÈRE.

[From a water-color by S. P. T.]

severe attacks of asthma prevented her from venturing on ice excursions, and caused them great anxiety. So the holiday joy was somewhat clouded.

Mr. Flemwell wrote in later years to Mrs. Thompson :

“As you know, Dr. Thompson was never happier than when painting ice; neither, as I think, was his work ever happier. Ice is, for painters, one of Nature’s problems, and I have never met any one who, with his brush, went more truthfully to the heart of ice than did Dr. Thompson. His method was simplicity itself, his technique broad and direct. By quick, simple washes, well calculated beforehand, he arrived at giving the substance, body and texture, of ice, better than any one else of my acquaintance.

“And he revelled in it. So much so, in fact, that I remember being nervous for him planted for hours in the midst of these treacherous seracs below the great ice-fall on the Argentière Glacier, and I induced him to take a guide with him—some one who could keep an eye on the movement of the ice.

“But in all things Alpine he had keen interest: birds, butterflies, flowers—he could talk about them all, and with always something informing to tell one about them.

“One day we left the Planet and scrambled up above the railway, before it crosses the river to call at Les Tines, and there we lay in wait for the sunset glow upon Mont Blanc—lay in wait to slay it with our paints and brushes.

“Literally we did slay it, too!—for its gorgeous, fleeting colouring was more than a match for our powers—and we had nothing to show to anybody when we returned to the hotel!

“The next day, however, up to Montanvert, Dr. Thompson did a really fine thing, catching to the life the bleak and terrible austerity of the Aiguille du Dru—whilst I with my back to him painted Les Charmoz.

“Well do I remember that walk up to Montanvert, and the chat we had about Ruskin, and the scraps of Tennyson which Dr. Thompson chanted to Mont Blanc—‘Come down, O maid, for Love is of the valley, come thou down.’ . . .

“I remember pointing out to him that, probably, the lady was safer where she was, and knew more about real love, up there ‘With Death and Morning on the Silver horns,’ which tickled him immensely.

“Afterwards, when he returned to England, he copied

out the passage in full from Tennyson, and sent it to me. I have it now."

During several summers when neither Switzerland nor Scotland was visited he painted some successful colour studies on the coast of Suffolk near Walberswick. One of these, a golden sunset seen across the marshes, he gave to his friend Sir William Crookes, on the occasion of the celebration of his golden wedding. In later years he exhibited in the Royal Academy occasionally, but he did not put prices on his pictures for many years, and only parted with them as gifts to some of his friends.

One little sketch which he made of the old town of Dinant on the Meuse, with its quaint church spire, and picturesque house roofs, has now, since the war, a melancholy and tragic interest. It was made in 1897 when he and his (artist) brother Tom went for a tour at Easter-time in the Belgian Ardennes.

In 1916 the following letter appeared in *The Spectator* written by a man who had met Thompson at Dinant :

"The late Silvanus Thompson was an expert in the manufacture of French limericks. In the spring of 1897 he was staying at the Tête d'Or at Dinant (now, alas, a heap of rubble !), and quickly made friends with all the party there. Most of us went with him one afternoon to Givet, and after tea at the hotel he started a French limerick competition. His was easily the best, but unfortunately I remember only my own effort. . . . A short time after several of the party met with pre-arrangement at Laroche, and here Thompson had a reverse. Sitting down to make a water-colour drawing of the steep little street which leads up to the chapel, he was surrounded by children and some grown-ups. To the uninstructed eye of the writer, the drawing seemed to possess some charm, but a workman, passing by, asked a bystander, 'Is it any good?' 'Oh, no,' was the answer, given with decision and a shrug of the shoulders. . . .

"From Houffalise the next day, as we drove back in the dark to Laroche, through the woods, the owls were very noisy. Some one in the carriage started the fable :

"Maître hibou, sur un arbre perché,
Tenait en son bec un fromage. . . ."

"The driver at once leant back from his seat and supplied the correction :

"*Maitre corbeau, sur un arbre perché.*"

"Thompson produced another fable, then the driver his in turn, and it was Thompson whose memory lasted the longer."

From Laroche Thompson wrote to his wife :

"This is our last day in the Ardennes, and, unfortunately, it is a dull and showery morning.

"Yesterday was a fine bright day, and we went an expedition to Houffalize. In the neighbourhood both of Laroche and of Houffalize the country is fine, and the four miles drive along by the river Ourthe was splendid.

"So far I have got but two sketches—one of Dinant, the other of the castle of Montaigles, and neither of them very satisfactory. I hope the weather will let me get one here before we go."

Thompson used occasionally to have small reproductions made of some of his sketches, generally by photogravure processes. He used these as Christmas cards, and often received appreciatory messages about them from his friends. In 1897 he reproduced one of his sketches of the Glacier above Lake Louise in the Canadian Rockies.

During the week's excursion to the Rocky Mountains, in company with his fellow members of the British Association, Thompson made about twenty sketches, all most effective, though sometimes only taken from a railway platform or an observation car. When he reached Banff, near Lake Louise, he spent a whole day sketching, while the rest of the party made an excursion elsewhere.

Of another Christmas card, a reproduction of a sketch of the "Aiguille Verte," Mr. R. Catterson Smith, the head of the Art Department at Birmingham, wrote: "I have just received your extremely nice Xmas card. It is a fine and romantic composition, full of the loneliness, mystery and glisten of the Alps."

From Mr. A. W. Rimington, an artist friend, Thompson

received great encouragement to hold a special exhibition of his work. He wrote :

“I was much struck by your Alpine water colours.

“I think some of them are quite exceptionally interesting and beautiful, and it seems to me a pity you should not exhibit them as a series.

“If I could be of any use to you in arranging for an exhibition of them—which I do not think would be difficult, please let me know.”

Thompson talked sometimes of having a “one man” show, but the leisure to arrange and prepare for it did not come. During later years, however, when he began to take a rather longer holiday, he used to finish up his sketches in September after returning home, and then invited his friends to come and see them on a Saturday afternoon at “Morland.” Some were sent also to the Annual Exhibition of the Friends’ Portfolio Society, held in a large drawing room or studio.

After his death over a hundred of his pictures and sketches were exhibited in the large hall of the Alpine Club, kindly lent for the purpose by the committee of the club. They were arranged and hung by a member of the committee, Mr. J. Walter West, R.W.S., and the artist’s daughter Sylvia (Mrs. W. Hanbury Aggs). Some of the finest pictures were lent by members of the family or friends to whom they had been presented. The show included four unfinished sketches begun at Misurina in the Italian Alps in July 1914, and interrupted by the tragedy of the European War.

During the exhibition, which lasted a fortnight, most of the pictures were bought by Thompson’s friends. A large sketch of a natural ice arch on the Argèntière Glacier was purchased by the Old Scholars’ Association of Bootham School, where it now hangs, along with another of trees and rocks, the “Gorge of the Giessbach, Axalp,” presented by an old scholar.

Of the art of music, especially of orchestral music, Thompson was an ardent devotee. From the time of his student days in London, when he heard a number of



THE AIGUILLE VERTE FROM "LE PLANET."

From a water-colour by S. P. Thompson.

Wagner's orchestral works performed in the Albert Hall, he had a great admiration for them. While living in Bristol he used to be a frequenter of the weekly orchestral concerts in the Colston Hall, conducted by Mr. George Riseley.

In 1880 he wrote to him :

"Will you allow me, as a humble supporter of your Monday Concerts, to thank you personally for the excellent performances you have been giving us of late, and in particular for the Tannhäuser Overture of last week? You are to be congratulated most heartily on the progress of your work. I am desirous of doing what little I can to help on the success of this movement, so I hope you will pardon me for the suggestion I now wish to make. Accompanying this note is a copy of the score of Wagner's *Ride of the Valkyries*, with which you are doubtless acquainted already. Your success with the Tannhäuser Overture is quite enough to prove that this other *morceau* is quite within the capabilities of your excellent band."

To this Mr. Riseley replied :

"You know I am always glad to have a chat with you on music. Do you think the *Ride* will take? I am going to do the two introductions in *Lohengrin* at the next. If at any time you know of anything worth playing, do please advise me."

On several occasions Thompson suggested pieces which he had heard elsewhere, and which did generally "take" well in Bristol also.

When writing to Miss Henderson he mentioned meeting Mr. Riseley, and said :

"We had a lot of talk about music, etc. He asked me to write an account of *Tannhäuser* for the next programme. I wrote off last night to Alice, begging her to send me the libretto that I brought north—at Easter, I think it was."

Thompson did all he could to persuade his wife and her sisters to play Wagner's music as arranged for the piano. They did their best for him, as it gave him great pleasure, recalling what he so much enjoyed on the orchestra ; but the result was never very satisfactory from the musical point of view.

When he came to live in London, he and his wife were constant attenders of the orchestral concerts given in the old St. James's Hall under the baton of Henschel or Richter ; and later on, but not so frequently, at the Queen's Hall under various conductors. He was always much interested in the art of conducting, and delighted to sit sometimes behind the orchestra and watch Richter or Sir Henry Wood.

Fortunately, his own family were musical. His eldest daughter Sylvia began to learn the violin when very young, and studied afterwards at the Royal College of Music under Señor Arbos for five years. Thompson often went to the College Concerts during the years when Sylvia was playing in the orchestra, then conducted by Sir C. Villiers Stanford, and greatly enjoyed them.

A few years later Dorothea began to play the 'cello, and, with either their mother or Helen at the piano, he was able to enjoy home trios, without having the fatigue of going to town and returning late at night. He always found great rest and refreshment in listening to music. His youngest daughter Irene had a good soprano voice, which was well trained, and her singing gave him much pleasure.

In September 1910 he wrote to his wife :

"Helen and I went last evening to the Queen's Hall to hear the Siegfried Idyll and other music. Every seat in the hall was sold, when we got there, except orchestra seats.

"So we sat behind the violins, and heard all from behind. The horn player was magnificent, and the kettle-drum performer a perfectly amazing musician—an artist to the finger-tips. The singers were good—both Germans—but we did not hear them to advantage.

"To-day has been a lovely day—with an Italian sky and warm sunshine. I walked across the Heath this morning, and returned from Finsbury at four p.m. to do a bit of painting before daylight faded. I have been pulling together the Macugnaga Glacier, and find it a tough job—but it is like ice. To-night we have had a lot of music ; Irene is in good voice. Dorothea played the piece given her by the local composer at Halesworth. It is not bad."

In a lecture given at the Royal Institution on the "Physical Foundation of Music" Thompson aptly expressed

some of his thoughts and feelings about that art. After a long experimental demonstration of the physical phenomena of music, he closed by saying :

“ Though a science, music is before all an art, and can be interpreted only by the artist. . . . No analysis, however searching, will explain away the thrill that runs through us as we listen to some simple phrase or *motif* which recalls the passionate andante, the gay barcarolle, the massive triumphal march, or the wailing *Miserere*. . . . Art that is true fears nothing from analysis ; it is beyond and above its reach.

• “ And music, the most refined, the most subtle, the most spiritual of the arts, defies analysis more effectually than any. Our enquiry leaves its emotional and spiritual power untouched, unchanged :

“ For music, which, is as a voice,
A low voice calling fancy, as a friend,
To the green woods in the gay summer-time,
Seeing we know emotions strange by it,
Not else to be revealed . . .
. . . is earnest of a Heaven.”

Thompson was well read in Browning, and had a profound admiration for much of his work, though, unlike so many others with whom he shared this sentiment, he also enjoyed Tennyson's melodious verse with its rich illustration from natural phenomena. These two poets, and Matthew Arnold, inspired him in the production of verses which have been much appreciated where they have come to be known. In the first instance they were read at meetings of the Westminster Portfolio Society, and afterwards in 1892 were, with one other poem by another writer, privately printed for presentation to the members in the form of a little booklet called *Monodies*. His feeling for poetry finds its best expression in these verses, which are therefore quoted.

AFTER READING “ PARACELsus ”

“ I shall arrive,” he said, “ in His good time.
I see my way as birds their trackless way.
God guides me and the bird.” O faith sublime
Of him who dares aspire nor feel dismay
To learn the workings of the Master Mind,
To climb transcendent heights nor look behind,

To win the secret of the Universe.
 'Tis God who calls us to aspire—to know ;
 For ignorance is the great human curse.
 Knowledge is God-like : though the way I go
 I know not. By what crooked paths or plain
 The circuit leads, the toil will not be vain
 That brings me onward to the unseen goal.
 Error decays, but knowledge shall survive.
 Clear is the call. " I go to prove my soul.
 In some time—His good time—I shall arrive."

ALFRED TENNYSON

1809-1892

I (FIRST OF THREE VERSES)

"Master of mystic music, thy great voice
 Is heard no more. Across the moonlit space
 Whence thou art passed thy footfalls leave no trace
 Like the great King, the Arthur of thy choice,
 Blameless in deed and fearless in the fight,
 First in the quest and foremost in the field,
 Borne through the tingling darkness of the night
 After his last weird battle in the West
 Into the valley of Avilion——
 Valley of silence and of endless rest—
 So thou into the Vale of Death art gone,
 By weeping shades into the darkness borne :
 Perchance, like Arthur, in the promised morn
 Of golden ages, when thy wound is healed,
 To come again to claim thy sword and crown,
 Thy plumèd casque, thine own untarnished shield,
 O stainless singer of undimmed renown,
 Master of mystic music, whom we mourn."

Of the value he placed upon good prose and proper literary setting of all thought, he spoke in his Presidential Address to the "Sette of Odd Volumes" (see p. 250), but apart from the form which he chose as fitting for his own particular literary matter, he was greatly interested in style of speech and of versification. This was apparent in some of his slighter essays for the Portfolio Society, such as those on "Ballades" and "Bouts-rimés," for illustrating which he used his knowledge of Swinburne. He delighted in the most difficult of all the poetical forms, the sestina, his favourite example being one by Dora Sigerson Shorter. For modern poetry, with the less rhythmical form he cared little,

but he often cut poems out of current papers and periodicals, and kept them, though he enjoyed no leisure to make a literary scrapbook.

Thompson had an excellent memory, and up to his fiftieth year never used his pocket diary, except to enter occasional appointments, or to remind himself of the birthdays of his numerous relations.

But in 1900 he adopted the habit of carrying about note-books, after the manner of Kelvin's "little green books," his being blue, and stamped with the sign of Finsbury Technical College.

A friend once remarked to one of Thompson's daughters, "I always imagine your father must have some extra coils in his brain, which seems to master so many more branches of knowledge and skill than an ordinary one." If it were possible to reproduce the pages of his little blue note-books, readers might find there some indication of the workings of his mind. He used to fill the note-books from both ends, beginning at the back with theology and philosophy, frequently reserving the first page or two for noting down the names of books to be read and "books to be lookt at," and crossing them off when seen. One year the numbers ran up to forty, another year to fifty-two. Then would follow extracts and quotations, frequently in one of his five foreign languages, Latin, Greek, French, German or Italian, these last generally from Dante; extracts ranging in date from the writings of the early Fathers to the current periodicals, mostly prose, some poetry. The other end was mainly devoted to scientific work, again lists of books, perhaps headed "To be lookt at in the B.M.," followed by notes on visits to works, notes of and for important lectures, diagrams of all kinds of apparatus, calculations of dynamos, graphs, or harmonic curves (the paper was finely ruled in squares on purpose for such work), hints of speeches at the University or some technical school, caricatures of people present at the meeting; the latest Marconi development, some new device for producing an effect of polarised light like the atmospheric effects; a note headed "*Optics and Artists*, 'Beata Beatrix' of Rossetti, see the shadows on

the dial ; evidently it was about 1 a.m. in the Arctic Circle with the sun at least 30° above the northern horizon ! ” A few pages further on : “ Influence of Accuracy of Language on Accuracy of Thought, incorrect use of terms, Ambiguity, Neglect of study of Greek, Shunt Dynamo, Polarity, Entropy.” Then a page of queries, some of a mathematical nature : “ Is there a 9-point sphere, the analogue in solid of the 9-point circle ? ” with a Latin quotation about it ; following closely on the same page : “ What is it that remains permanent in permanent magnets ? Magneto-motive force ? Flux ? Energy ? How does interior reluctance change ? ” A little further on is a page headed “ Science and Temperament,” with a dozen sub-headings, references to Newton, Huxley, Faraday, Poincaré, and the note, “ Germany : No scientific amateurs ; No society entertainers.” In the next year’s volume the same theme appeared again, with considerable additions and many new sub-headings. The writing is occasionally hardly legible, indicative of crowded underground carriages and omnibuses, for he often made use of these opportunities for consulting his little blue book and adding to its contents. Between the leaves are some small botanical specimens, brought from a holiday walk for identification ; on another page is a note of the names of some plants, *Pyrus eleagneaifolia* (wild olive-leaved pear), etc. There is half a page devoted to quotations from St. L. Strachey and Rudyard Kipling, followed by a cramped compilation headed, “ A Scientific Man’s Views on Politics,” facing a page of short quotations from Virgil, Diderot, Carlyle, Nietzsche, Huxley, Ruskin, etc., on the Philosophy of Life. A few pages further on is a four-line extract from Barry Cornwall.

“ A picture varying with the varying years ;
 A long Love-dream, some hopes and many fears ;

 “ A battle (lost or won) blood-red with strife,
 Is that dim human Riddle called—A life ! ”

One of the books noted in the same volume is Warren’s *Death of Virgil*, and on another page an extract from it, repeated in the next volume, and sent to a friend, an Oxford

man, with the reproach, "What! you don't know the finest bit of English poetry that Oxford has produced since Matthew Arnold's time? Fie upon you! You are just absorbed into the sixteenth century I think." The quotation was :

"To know, to do, and on the tide of time
Not to drift idly like the cockle-sailor
Whose pearly shallop dances on the blue,
Fanned by soft airs and basking in brief sun,
Then at a cloudlet sinks, with scarce a ripple;
But to steer onward to some purposed haven
And make new waves with motion of our own,—
That is to live."

With these lines Thompson closed his *Life of Kelvin*.

CHAPTER XV

RELIGIOUS TEACHING AND WRITINGS

“ Truth is not to be found by refusing to seek it ; nor in the quest must we count the cost. There are many ways of arriving at truth ; many views of truth. There are other windows opening on to heaven than those of the nursery in which we were brought up ; and some are wider, and some face toward the dawn.”—*From the “ Quest for Truth.”*

THOMPSON was born a member of the Society of Friends, according to the regulations of that body which registers, as members, those children whose parents are both in membership, and he remained a Friend to the end of his life.

At the time of his birth the Society had, with nearly all other English religious bodies, shared in the great wave of Evangelical thought which swept through the country in the early part of the nineteenth century. A good many members of the Society had adopted these beliefs and opinions with so much fervour and so little reserve as to become, as Thompson in later years phrased it, not merely evangelical, but ultra-evangelical in their attitude of mind.

In the home life of the Thompson family the religious atmosphere was a very quiet one, and the parents were more concerned to live the Quaker life than to talk about it. But in those middle years of last century there was a great deal of preaching to the boys and girls of the schools, and visiting ministers were constantly putting before them the evangelical point of view. To its appeal a considerable proportion of young Friends responded with great enthusiasm and whole-hearted devotion. Thompson especially came very much under its influence, owing to his association with his mother's younger brothers, Richard and Joseph Tatham of Settle, both deeply religious young men of fervid and saintly character. John Ford, the first Head Master

of Bootham, was also a man of the quiet and gentle evangelical school.

While still a junior master at Bootham the study of science led Thompson to question some of the articles of faith laid down by those who belonged to the extreme evangelical school of thought. In religion he was always deeply interested, but he felt a repulsion from some of the forms in which it was presented. At the age of twenty he was already seeking to reconcile the teachings of science and religion. In an article published in the *Bachelor's Papers* in 1871 he wrote :

“The notion of irreconcilability probably arises from a double misunderstanding : first of the theologians, who are vexed that science should take upon herself to explain the manner of those vital causes of which they imagined themselves to possess the key ; and, secondly, of the physicists who, by the rigorous logic of their intellectual training, are unable to understand that in other departments truth may be attained by other methods than those of the five senses.”

He then went on to discuss religious beliefs in the earlier ages of history, showing how religion was gradually evolved until the time of the Christian era, and how in the Middle Ages Christianity was in the trammels of priestcraft, and even after the Reformation permitted small range to the scientific enquirer. He then touched on the theory of scientific evolution, and ended with the following conclusion :

“Sincere scientific study, conducted even to the furthest limits of research, revealing everywhere the evidence of a grand purpose running throughout all the realms of material nature, cannot fail to exalt the glory of Him of whom, and through whom, and to whom are all things.”

Thus, even before he began his studies under Huxley, Frankland and Tyndall, Thompson had arrived at being in the position of a seeker, and in the meetings he attended was not afraid to speak of the faith which was his. But he began to question the popular terms of expression of religious ideas more and more, and at length, for some years, he felt it best to wait and be silent. In 1880, when

first talking of these questions with his future wife, he said, "I am now considered a bit of a heretic." His heresy consisted chiefly in his not being able to repeat the shibboleths of the current expressions of religious truth. These were seldom used in the more reserved atmosphere of the Scottish Quaker home of the Hendersons, who followed the old Quaker way of life in simple fashion, but with wider sympathy for art and literature than Thompson had known at home.

When living in Bristol, Thompson was a constant attender of the Friends' Meetings, and occasionally spoke in them. Later, on his removal to London, he attended Westminster Meeting in St. Martin's Lane.

He gradually came to feel—and his opinions were shared by others—that the Society of Friends during the seventies and eighties was drifting more and more into Methodism and approaching nearer to other Nonconformist bodies, while forgetting its ancient call to a mystical and inner religion.

Still he remained loyally devoted to the Society, and, although his life was a very busy one, he did not shirk what he felt to be his duty in taking a share of the work for it.

Having no paid ministers, the Society depends on the voluntary services of its members. Each congregation has its appointed secretary, called the Preparative Meeting Clerk. For three years Thompson acted in that capacity, which, in a large meeting of over 300 members, entailed a considerable amount of work.

About 1889 he began to take more part in preaching in the meeting. One of his fellow members of the congregation described his ministry thus :

"He spoke with deliberation and great reserve. There was a fine wideness of vision, studied emphasis, courage and fervour, but also balance, detachment, and wisdom. There was no declamation, no gesture, and very little direct appeal. But the effect was wonderful, and the hearers very willing, reverent, and responsive. He would choose as his text a line from Browning, Tennyson, George Meredith, or the

Book of Wisdom ; or he would dig up from a long dead, hidden treasure-house some brilliant and glistening gem of thought and polish it before our eyes. He would draw his similes from the ends of the earth, from history, science, literature, art or music, and he would unfold, reveal, prophesy. He was a seer, and he came to tell us what he had seen—and so, all unconsciously, and as if by accident, he became a prophet. I well remember how I discovered he was a prophet. One Sunday morning in 1892, he rose from his seat on the side gangway at Westminster, and lifted our hearts and minds into the vast spiritual world in which he dwelt. I had never heard a Quaker sermon like it.

“He spoke of what he had seen, and what he knew. He spoke with courage, fervour, vision.

“At that time he spoke but rarely, and always, as it seemed, with a definite message, a live coal from the altar had touched his lips.”¹

It was soon after this occasion that Silvanus Thompson was appointed to the office of elder, and frequently it was his duty to sit in the gallery facing the congregation. Seeing assembled before him the members with all their varied spiritual needs, messages began to come to him more often, messages which brought comfort, hope, and strengthening of faith to many present.

In the year 1895, at the request of some of the Friends who were concerned for the state of the Society at that time, a Conference was appointed to be held in the autumn at Manchester. This Conference was epoch-making in the history of the Society. Papers were read by many of the most advanced thinkers among its members. Professor Rendel Harris of Cambridge, the profound Oriental scholar, Principal Graham of Owens College, Manchester, Dr. Robert Spence Watson of Newcastle, were among those who took part. Miss Frances Phillips Thompson of Birkenhead, Thompson's cousin, read a paper, and he himself contributed one entitled, “Can a Scientific Man be a Sincere Friend?” From Manchester he wrote to his wife:

“I snatch a few minutes before Conference resumes. This morning's discussion of social questions was very good. Dr. Spence Watson opened well. Cousin Fanny Thompson

¹ Written by Sir George Newman in *Friends' Quarterly Examiner*.

followed with an admirable modern-view paper. Except for a few croakers the speakers kept a very high level—and the tone was to be admired throughout. This afternoon Edward Grubb leads off, then I follow. I shall have a very large audience—there were over a thousand this morning, and there will be more.

“ We went with Ellwood and William Brockbank, a party of twenty of us, including Cousin Charles Thompson of Morland, Luke Woodard of Carolina, Joshua Rowntree, etc., to lunch at the Reform Club.”

Thompson began his paper by saying :

“ Please to note that the question on which I have been asked to write a short paper is not whether a Friend can be a scientific man, but whether a scientific man can be a sincere Friend. The former query is sufficiently answered by the mere mention of three names : John Dalton, Luke Howard, Daniel Hack Tuke—all Friends, all indisputably men of science. The other question before us can only be answered by inverting for the time our point of view, and, starting from the position of the man of science, enquire whether that position is compatible with the acceptance of the particular views of Christianity which distinguish the Friends from other bodies of Christians.

“ You know beforehand what my answer will be. Were it not an affirmative answer, I should not stand here to-day ! . . . What, then, is Science ? ”

This question he proceeded to answer, then went on to say that he did not admit that there could be any conflict between science and religion. “ That which is divine truth, modern thought will leave wholly untouched, or will touch but to confirm.”

He closed with the words :

“ Being Friends, we are, to the unspeakable gain of our souls, preserved alike from those diseased word-battlings that afflict so many honest and sincere, but less enlightened Christians, and from the torturing fear that science may one day undermine our faith. We have a stronger, because a purer faith. We have learned that sin, being a spiritual disease, requires a spiritual remedy. We have advanced beyond the materialistic notion that sacrifice is better than obedience. We have learned that there is no infallible

Pope, no infallible church, no infallible book. We have learned that creed is not separable from conduct; that a man's religion is not what he professes, but that which he lives. . . . All that is true, all that is real, all that is vital will remain, will prosper, will grow. . . .

“ ‘Thanks to Him,
Who never is dishonoured in the spark
He gave us from His fire of fires, and bade
Remember whence it sprang, nor be afraid
While that burns on, though all the rest grow dark ? ’ ”

The papers read at the Manchester Conference were afterwards bound together and published as a volume. Thompson's paper was also printed in pamphlet form. His friend Sir William Ramsay said to him, after reading it, “Almost thou persuadest me to be a Friend,” and went on to express his agreement with much of its reasoning.

From Baltimore, U.S.A., he received a letter from a revered Friend, Joseph J. Cornell, whom he had met at Chicago in 1893, thanking him for his testimony to the old Quaker doctrine of “the Indwelling of the Divine Spirit in the soul of man.” He concluded by writing :

“But I need not weary thee with many words. I remember with feelings of deep satisfaction our short meeting and mingling in Chicago, and the savor of thy testimony to the sufficiency of the Inner Light, in our Meeting, is vividly fresh in my memory, and so I felt impelled to, in this form, send thee a loving greeting of sympathy and encouragement for thy strong words in that Conference.”

In 1903 Thompson's gift as a preacher was recognised by the Westminster Monthly Meeting, and he was recorded as a Minister of the Society of Friends.

In a memorial drawn up by direction of this Monthly Meeting, soon after his death, the following words occur :

“A feature we would notice in our friend's character may be spoken of as his sense of worship. The man of science resisted the temptation to arrogance, which knowledge sometimes brings, . . . that he might humble himself before God. In the ‘real presence’ he found that the link between man and his Maker needed no outward symbol. His influence as a worshipper in his own Meeting at West-

minster was felt to be precious. It was not alone his own approach to God, expressed oftentimes in prayer, in which he would lead the thought of the Meeting with very simple and sincere words; but also his sense of the worship of others, so that the Meeting became a true fellowship in which his own or other's service, silent or vocal, might find its fitting and harmonious place.

"The gifts of one did not mar those of a brother or sister. A preacher of power himself, he would hold back, and often sit silent when he felt that the word was given to another; and when something seemed to hinder the course of true worship he was often able to bring it back into its true direction."

There exist several printed addresses which Thompson gave on special occasions, though many, including some of the best, were never written or printed. In 1905 the Friends decided to give special public addresses in the chief cities of northern England at the time of holding their Yearly Meeting at Leeds for the first time for two centuries out of London. The subject chosen was "Christ in Modern Life," and Silvanus Thompson was asked to deliver the address at Liverpool. Each speaker was free to interpret the subject as he pleased. On May 29th, 1905, he wrote to his wife:

"The evening meeting in the old meeting house at Liverpool was very large; it was quite full, some 650 people being present, of whom nine-tenths were certainly not Friends. Dr. Thorp made a good President. The people listened most attentively—hung upon my words, and seemed to realise that I really had a message for them. A number of folk came to me afterwards, amongst them Roy Coventry, J.C., my old Flounder's tutor, a former Bristol student, and one of Professor Marchant's demonstrators. They all asked for copies of my address."

In the following year Thompson spoke very strongly in the Yearly Meeting on the drift of the Society of Friends away from its first principles, and the consequent loss of members by their joining other religious bodies. In pleading that Friends should return to the principle for which they had stood from the beginning, he said:

"But what do we as Friends stand for? Not for a bundle

of negations, not for a partitioning of the country into districts called Quarterly Meetings, nor for an organisation of a hierarchy of elders, overseers, and ministers. These are all the veriest details, which might be abundantly varied without departing from the truth. What was it that George Fox and his fellow workers went out to preach? What was the revelation committed to them? What was it but the fundamental principle of the Inner Light of Christ shining into the heart and vitalising the man from within? What was it but the Divine Immanence in the soul, making discipleship the conscious obedience to the inwardly revealed Will of God? It was an evangel of Inspiration, a Gospel of Divine Illumination which had entered into their lives. . . . All the rest followed from this principle; the non-necessity of the purely institutional and traditional things—no priest, no ritual, no liturgy, no ordinances. Men were to be saved, not by machinery, not by articles, nor ordinances, nor liturgies, nor by priestcraft, but by listening to the Voice of God and by doing His Will.”

He went on to show how degeneration from these ideals had crept, and was creeping, into the Society:

“The Society must awake,” he cried, “must renounce. It must be willing to lose itself, to save itself. . . . We must neither include nor exclude too widely. . . . We know of no Inner Light but that of the Lord Jesus Christ in the soul. Let us not be slaves of words. We recognise no Inner Light that is not the emanation of God Himself. By whatever name we call it—whether Inner Light, or Holy Spirit, or Christ within—it is the same thing.

“So far from our mission being ended, it has scarcely begun. More than ever does the world need the message the proclamation of which was laid upon our forefathers in this body, and which, after two centuries and a half, it is still called to uphold. . . . to forsake the ‘Lo! here’ and ‘Lo! there’ of the popular churches, and to look to the Christ, who is still the need of to-day—the Christ within.”

In the same year 1906 Thompson was invited to give an address at York Meeting House during the time of the holding of the British Association Meeting in that city. It was given on the Sunday evening, and was very largely attended by members of the Association, as well as by the Friends who usually formed the congregation there.

He chose as his subject a discussion of that aspect of religion known as Mysticism ; the address was afterwards incorporated in an article published in the *Friends' Quarterly Examiner*, under the title of "Intuitional Religion." He took as his text the motto which the ancient University of Oxford has used for centuries, *Dominus Illuminatio Mea*, and showed forth the growth of the ideas of Divine Illumination, of the Light of Conscience, the Inward Light, warning his hearers lest they should be misled by analogies and metaphors drawn from a study of light in its physical sense. From the mystic writers, William Law, Erskine of Linlathen, Henry More, etc., he gave many quotations. He classified Mysticism under the heads of poetical, apocalyptic, ethical and quietist, illustrating his classification by examples.

The address lasted about an hour. Sir William White, a member of the Association, described it to another scientific man as the best lay sermon to which he had ever listened.

When the Yearly Meeting met at Birmingham in 1908 he again gave a public address, this time on "Agnosticism and Christianity."

Many requests for Sunday evening addresses from Meetings up and down the country now began to reach him. But he was too busy to devote much time to going about. One of the last of these public addresses was given in 1913, in a large public hall to an appreciative audience ; it was entitled "The Sacrament of Life," and with another on "Materialism," of about the same date, appeared as chapters of the book *A Not Impossible Religion*. His Sunday evenings were largely devoted to their preparation.

During the years which followed the first holding of Yearly Meeting out of London in 1905, and partly as a result of fresh enthusiasm awakened then, there arose among the younger Quaker members a great revival of interest in the meetings for worship. Groups of young Friends were formed to visit the meetings throughout the country, and to try to bring into them a renewal of the spirit of the gatherings of the early Friends, in which there was more willingness to wait in silence for a spiritual message to be given.

Numbers of the students at Oxford, Cambridge, Birmingham and elsewhere were interested in this movement, and Thompson was asked on several occasions to come to their meetings and speak to them. Twice he went to the Woodbrooke Settlement, near Birmingham, to address the students there, and he paid two or three visits to Cambridge for the same purpose.

When visiting the latter town he several times stayed with the venerable Canon Bonney, the geologist, with whom he enjoyed many talks on scientific and religious topics.

This revival among the younger Quakers came to be known as the "Young Friends' Movement," and it rapidly extended over the country. Thompson's third daughter Dorothea, a London college graduate, took an active part in it, and was a member of the central Committee.

In 1912 she went, with other members of the Committee, to visit some of the large bodies of Friends in the United States, where there was a similar revival of interest among the young. Thompson was deeply interested in the form of this revival. Some of its permanent effects were soon after tested by the outbreak of the war, when most of its young men members took up the strongest position, maintaining the Society's testimony to the unchristian character of all war, and many suffered imprisonment as conscientious objectors to military service.

In the summer of 1914 Thompson was invited to deliver the "Swarthmore Lecture" at the next Yearly Meeting of the Society. This Lecture is an endowed one, founded by Friends about 1907, and is given annually.

The Lectureship has a twofold purpose—first, to interpret further to the Society of Friends their message and mission; and, secondly, to bring before the public the spirit, the aims, the fundamental principles of the Friends. The Lecture is always published in book form on the day that it is delivered.

Thompson chose as his title *The Quest for Truth*, and began at once, during the summer vacation, to prepare the material for it. Fortunately much was done before the outbreak

of the European War had begun to throw extra work and strain upon him.

It was during his Easter vacation in 1915, spent with his daughter Dorothea at Falmouth, that he finally prepared the volume for publication, she assisting him with helpful criticism and correction of proofs.

As the Lecture is always publicly advertised, it was known that the audience would be a large one, so it was arranged that it should be delivered in the Central Hall, Westminster, which is much larger than the large Friends' Meeting House at Bishopsgate. It is, however, not so well adapted for speaking in. About 1,600 people were present. The Lecture was only briefly reported in the daily papers, but the printed volume, which contained a great amount of matter not read by the author, in addition to the numerous and lengthy footnotes, was reviewed in many of the publications of the religious press.

A good review appeared in *One and All*, from the pen of Dr. Currie Martin, M.A. The following quotations give some idea of the scope of the Lecture.

"The Professor sets out by giving a fresh and interesting account of the differences between truth, error, and falsehood, and of the vital distinction between truth and veracity. This treatment of words is not only useful in itself, but is a fine object-lesson in the importance of accurate language.

"The importance of maintaining intellectual integrity is next dealt with, and the great danger that besets us all in becoming the victims of prejudice. In a couple of pages the writer sets clearly before us the most common forms of hindrances to the Quest for Truth; these consist in over-respect for authority, false humility, the aversion from doubt, the tendency to temporise, the craving for originality, and want of precision in language and clarity of thought.

"We come next upon the passage containing the treatment of the Quest for Truth in various departments of knowledge.

"The Professor gives a striking instance of how mere accuracy may be misleading, and thus we see that a proper use of imagination is an essential element in the true Quest for Truth.

"Of special interest to us is the section dealing with

religion and morals. This is illustrated by a somewhat lengthy treatment of pious frauds, legends and folklore, full of suggestion and illumination.

"Careful study of this book can have only one result—clearness of vision and uplift of soul. It will be found to be of far higher practical value and of more permanent effect than many volumes which at the first glance seem to give richer promise of such results."

Another criticism in the Bristol paper, *The Western Press*, said :

"The book is marked by the same lucidity of statement and force of argument as characterised Dr. Silvanus Thompson's public speeches in this city in bygone years. In addition the book is remarkable for the wide range covered by its author in his search for the opinions of others on the points under discussion. These very numerous quotations in letterpress and footnotes are extremely apt, and add considerably to the value of the volume."

A reference in the Lecture to the strange use of words employed by Mrs. Eddy in her writings on Christian Science, brought upon its author several letters in defence of her language. He also had a lengthy correspondence with some members of the Society of Friends who had not fully understood some of the points of his arguments.

Thompson did not by any means confine his attention to the Quaker aspect of religious truth. He was a wide reader of theological works, both ancient and modern. His friend Sir Oliver Lodge published several works on religion and philosophy which interested him greatly.

In 1904 he wrote to him :

"Many thanks for your address on 'Mind and Matter,' which will give me food for many days.

"In the main I agree with the line you take. There must be a monism, ultimately ; but no, not Haeckel's.

"What a pity that any scientific man should be so blatant ! He is doing little better than set up a new dogmatism, which can at best be little better than the old, and may be far worse.

"But what do you mean by the sentence, 'Direction is not a function of energy' ?

"Surely it is, just as much so as matter? Are there not energy-paths, for the existence of which Poynting, and you yourself, are responsible as sponsors? Are not these the trajectories of energy, just as truly as the parabola of the projectile or the stream-line of the fluid?

"Energy is an undirected quantity in one sense, just as truly as mass is an undirected quantity. Is that all that you mean?

"Have you yet read the *Life of Bishop Creighton*? It is most deeply interesting. I came across the following, written in 1887, when he was Professor at Cambridge [after noticing the number of Universities in foreign countries in comparison with 'only two in England']: 'The English character loathes a multiplicity of ideas—so bewildering'! Only *two*!! He totally ignores Durham, London and Victoria: to say nothing of the Scottish four. 'With all his breadth, he is occasionally curiously narrow.'

About 1907 Thompson joined a small number of men of various denominations, who had formed themselves into what they called "The London Society for the Study of Religion." He and T. Edmund Harvey, Warden of Toynbee Hall (afterwards to become his son-in-law), were the only Quaker members. He describes the Society to Sir O. Lodge in a letter to him in 1912.

"You may have heard of our London Society for the Study of Religion, founded about seven years ago, in which members of a number of different beliefs, Jews, Romans, Anglicans, Baptists, Unitarians and Agnostics, etc., take part. We are but forty members or so, and have got to know and esteem one another very thoroughly. Baron von Hügel, Joseph Wicksteed, Rev. A. S. Lilly, Claude Montefiore, Professor Israel Abrahams, Rev. P. T. Forsyth, Mr. C. S. Mead and various other men, whose names you will know, are active members.

"We seldom meet less than twenty-five in number once a month, to read and discuss papers. We have had, as visitors, Sabatier, Father Semaria, Dr. Thomas Hodgkin, etc. At the end of each session we conclude with a dinner, when we try to have some visitor with us to discourse to us informally, and at short length after dinner. I am asked by the Council to write to you to ask you whether you would honour the Society by being its guest at our next dinner.

‘I hope you will be able to come ; and, if so, that you will consider this house your home for the night.’

Sir Oliver was, unfortunately, too much occupied to be able to come to the dinner.

Thompson, at intervals, read papers to the London Society, and was a member of its committee, and also served as President for one session. Their meetings were held at a small hall in Westminster. In October 1912 Thompson again wrote to Sir O. Lodge :

“I have been looking into your *Modern Problems*, which, if you will pardon me for saying so, seems to me the best of your lay (*i.e.* non-scientific) books. It will go on the shelves beside such works as Huxley’s *Lay Sermons*.

“Since Huxley’s days there is no scientific man who has got the ear of the public as you have, except the late Grant Allen, whose biology appealed, perhaps, more to people interested in living things than physics does. And he had a poor philosophy behind him.

“I don’t pretend to have read all the essays ; but I welcome some old friends as well as new ones. I like your chapter on Arbitration as far as it goes ; but it seems to me that it scarcely sufficiently emphasises the point that when mankind has really got into the scientific frame of mind in which the instinct will be to resolve problems by applying principles, and abhorring prejudice, there will be no chance of squabbles being settled in any other way than by law and arbitration, national and international.

“You have the ear of the public. Have you realised that the public needs to be told, not once, nor twice, that our rulers, politicians, administrators, legislators, are—(that is 95 per cent. of them) trained up in a non-scientific school of thought or no-thought ; and that their current measure of truth is—even when they are honest—of truth unsifted, of truth that has never been tested by first principles ?”

Three of Thompson’s oldest friends, Sir Oliver Lodge, Sir William Barrett, and Sir William Crookes, as well as some of his Thompson cousins, were deeply interested in Psychical Research, and in investigation of supposed spiritual manifestations. For a time he studied the publications of the Society, but he could never accept as proven the supposed messages from the spirits of departed friends. He could

never believe in the absolute honesty of the medium, and considered that there was nothing manifest which could not be explained by telepathy or thought transference, conscious or unconscious, on the part of the living.

Occasional references to the subject occur in his letters to Sir Oliver Lodge; in his intercourse with Sir William Crookes it was carefully avoided.

The following two letters to Mr. T. Bailey Saunders are further evidence of his devotion to modern studies in religion.

The first was written during the winter vacation of 1907 :

"Many thanks to you for your kind gift of your *Quest of Faith*. I shall have a first reading of it to-morrow afternoon in a snug arm-chair, and promise myself a treat.

"I see that your earlier chapters deal with Huxley. I sat at his feet for a time—literally, as a student—and had a tremendous admiration for him as a man, though I always thought him too much inclined to a dogmatism of his own. A few months ago I took, in company with a friend—a biologist and a thinker—a Sunday afternoon walk across the fields to Finchley to the Cemetery to revisit Huxley's grave. Already the tombstone is growing green. On the stone are these words :

"Be not afraid, ye waiting hearts that weep,
For still "He giveth His beloved sleep";
And if an endless sleep He wills—so best."

"I know not whence these lines come, and it is not perhaps without significance that, whoever caused them to be inscribed there, thought it needful to put the text from the Psalms into quotation marks.

"But to find them there at all is of much more significance, if it be that their inscription was by any direction of his.

"*Entbehren sollst du?* Of course I was familiar with this; and it was not this mocking phrase that was in my thoughts. It is some other passage that I have read elsewhere, possibly in the Eckermann volume, but which I cannot now find, where the ethical significances of *entbehren* and *entsagen* are contrasted. If you find it, please remember me."

The next letter is written in June of 1907.

"You were so good as to lend me two books: *As Others Saw Him* and *The Great Enigma*.

"These I now return to you with apologies for having

kept them so long. But only to-day have I managed to finish the former. It is distinctly good and interesting. As to Lilly's book, while there are plenty of interesting things, I cannot read it without continually finding myself pulled up by some implication or some *ignoratio elenchi* most subtly interwoven in the argument. It may not be consciously dishonest, but it is certainly disingenuous. There is always an *arrière pensée* somewhere lurking round the corner. I must re-read your *Quest of Faith* now that I have read the *Enigma*. The chapter on Spencer wearied me. I remember that your chapter on Spencer was also tedious to my thinking. I believe I was rude enough to tell you so.

“I suppose the fact is that years ago I found Spencer wanting, and his philosophisings on the deeper things wearied me. Certainly I prefer Spinoza as philosopher. But just now my head is full of other things: I am in the middle of a discourse to be let off as a presidential address to the amateur scientific folk of the South Eastern Union of Scientific Societies next week.

“It includes an attempt to whitewash the *Farbenlehre* of Goethe, that masterpiece of amateur science. Where and when did Goethe say: ‘Lässt uns doch vielseitig sein?’ I can't find it in the Eckermann volumes—perhaps you may know.”

It was in 1905, two years previously, that Thompson had been making a special study of the idea of *Monism*. In a printed paper entitled “Reconstruction and Restatement” he discussed some of the arguments employed by the advocates of that school of philosophy, pointing out that “there is undoubtedly bottom truth underlying the idea that life is, in its widest sense, *one*.” But he felt the philosophy as interpreted by Haeckel to be very inadequate.

The last paper read by Thompson in 1916 to the London Society for the Study of Religion was entitled “The Postulates of Religion,” in which he stated that in religion “some matters must be deemed to be true, because the denial of them would land us in absurdity or intellectual nihilism. Others are statements of permissive action, which none would dream of refusing.” These he considered to represent the postulates and axioms which exist in religion, though no universal agreement on such has been formulated.

He brought forward sixteen of these postulated propositions, together with the implications which they involved, and the discussion which followed was a very deep one, in which many members took part.

As one of his friends said :

“Thompson was uncompromising and sometimes severe in exposing error, or in dissecting half-truths, or perversions of the truth. He may also have sometimes over-emphasised aspects of truth which appealed to the scientific mind. But he was actuated solely by the love of truth itself, for loyalty to it was the very instinct of his soul. If, however, he wielded a trenchant pen, in personal touch and converse he was gentle and genial.”

Professor Frederic L. Paxon of California, who had at various times visited Westminster Meeting and heard Thompson preach there, wrote the following reminiscences in the *Friends' Intelligencer* of August 1916.

“Ten years ago a group of college teachers were discussing the habits of their European colleagues, and one of them chanced to remark that, in Europe, total abstinence was rare. To this statement two of the group, strangers to each other, objected vigorously, and each gave, as proof of his objection, the name of Dr. Silvanus Thompson. It was not an accident that this name occurred simultaneously to two casual acquaintances, for the impressive personality of Dr. Thompson was such that men naturally seized upon his attributes to give point and illustration to their arguments. To many of his American acquaintances, London and Westminster Meeting can never be the same now that he is gone. Truly balanced, far-sighted, sane, he had much of the practical spirituality of William Penn. He was a man versatile beyond our American custom.”

During the terrible war years, when men's minds were in great unsettlement, the head of the Browning Hall Settlement at Walworth decided to hold a week of lectures by scientific men to show that science and religion are not incompatible. Seven men of science, most of them Fellows of the Royal Society, were found who were willing to give

these addresses. Professor Sims Woodhead spoke on the "Continuity of Life," Thompson on the "Continuity of Religion," dealing in particular with the evolution of man's spiritual perception.

He had great sympathy with the work of the Browning Settlement, and helped to find speakers to complete their programme. He attended several meetings. He had expressed much hesitancy about speaking himself, as he had then such onerous duties at College, and it would take two or three weeks to prepare such an address. The committee said it was precisely because so much thought went into his addresses that they wished to secure him.

Sir Oliver Lodge had given the first address on "Help from the Unseen." All the addresses were afterwards published as a volume entitled *Religion and Science by Seven Men of Science*, and a Dutch translation was afterwards published at Haarlem.

It was during the last few years of his life that Thompson decided to publish anonymously some of the various addresses he had given, and began to arrange and prepare them for that purpose. He had also written down several suggested titles. This work was interrupted by his sudden illness, and left unfinished. T. Edmund Harvey, his son-in-law, edited the manuscript for publication. One or two chapters had to be omitted, and it was also much to be regretted that for the final chapter only the title, "Finis Coronat," was written.

Thompson had already prepared a preface to the book, in which he explained that the various chapters had been written at different times during ten years. He wrote :

"Doubtless the objection will be raised that the book does not present a consistent whole, but is made up of fragments ; that there is no connected system, no unifying theological basis. This is precisely so ; the chapters are merely *aperçus*, and do not claim to be other. A grievous error for centuries past has been that the theologians—well-intentioned, learned, and pious men—have tried to weave a consistent whole out of imperfect *aperçus*, and, having framed a system of logical consistency on this defective

basis, forthwith have branded as heresy any view of truth that did not fit in with their system. . . .

"To these outcasts of orthodoxy, to the honest and reverential seekers after spiritual enlightenment does the author now address himself. Of several things he is profoundly convinced. First, that the day is gone by when the essence of Christianity can be regarded as consisting in either dogma or literature. . . . The author publishes this work with the conviction that no advance in religious thought is possible unless the quest for truth, without fear of the consequences to accepted tradition, be ever accompanied by at least an equal regard for the preservation of a reverential spirit."

The volume entitled *A Not Impossible Religion*, published in 1918 by John Lane, met with an instant success, and in two months a second edition was issued. It seemed to meet the need of the spirit of unrest and questioning which arose in the years of war.

The reviews were almost unanimously favourable, and *The Times Literary Supplement*, *The Westminster Gazette*, *The Guardian*, *The Daily News*, *The Friend*, and many others gave great praise. Most of the faults found were those which the author had already acknowledged in his Preface. Reviews appeared in daily papers all over the country, from *The Bristol Times and Mirror* to *The Montrose Standard*. In the *Nation's Book Supplement* the book was described as follows :

"It is the loftiest idealism summed up in the words 'Follow Me,' with all their implications, that it preaches, and there never was a time in the history of the world when such a message might have come with greater pregnancy."

The Christian Commonwealth said :

"By distinguished work in his own profession, Dr. Silvanus Thompson left no mean legacy to the world ; and this book gives him a further title to be named among the bridge-builders who would make the seekers of truth and the men of faith realise that, so far from having any estrangement, they are brothers, whose faces are set towards the

same light. Surely it is eccentricity rather than diversity that would prevent any man from yielding to the persuasiveness of such words as these: 'All duty is divine, every place holy, every hour sacred, everything outward spiritually correlated with the inward. And the sacraments of God, if we would reckon them up, are not to be counted as two or seven, but are untold as the sands of the seashore.' "

THE HIGHER MYSTERY

" 'Heaven lies about us in our infancy' ;
 We try to touch it, but the blue recedes.
 The mystery fades ; no longer can we see,
 When Knowledge seems to overthrow our creeds,
 Heaven all about us. Gone, the light of old :
 The rainbow's foot no longer touches gold.
 Yet as the years beyond, 'mid joy and pain,
 Bring fuller knowledge, to our souls again
 Comes a deep sense that life is not a show
 Ending in nothingness. God's guidings flow
 In golden threads unseen athwart the gloom.
 And we, with clearer light that knowledge brings
 Learn the deep mystery of common things,
 An earnest of the heaven which is our home."

S. P. T., from "*Monodies*."

CHAPTER XVI

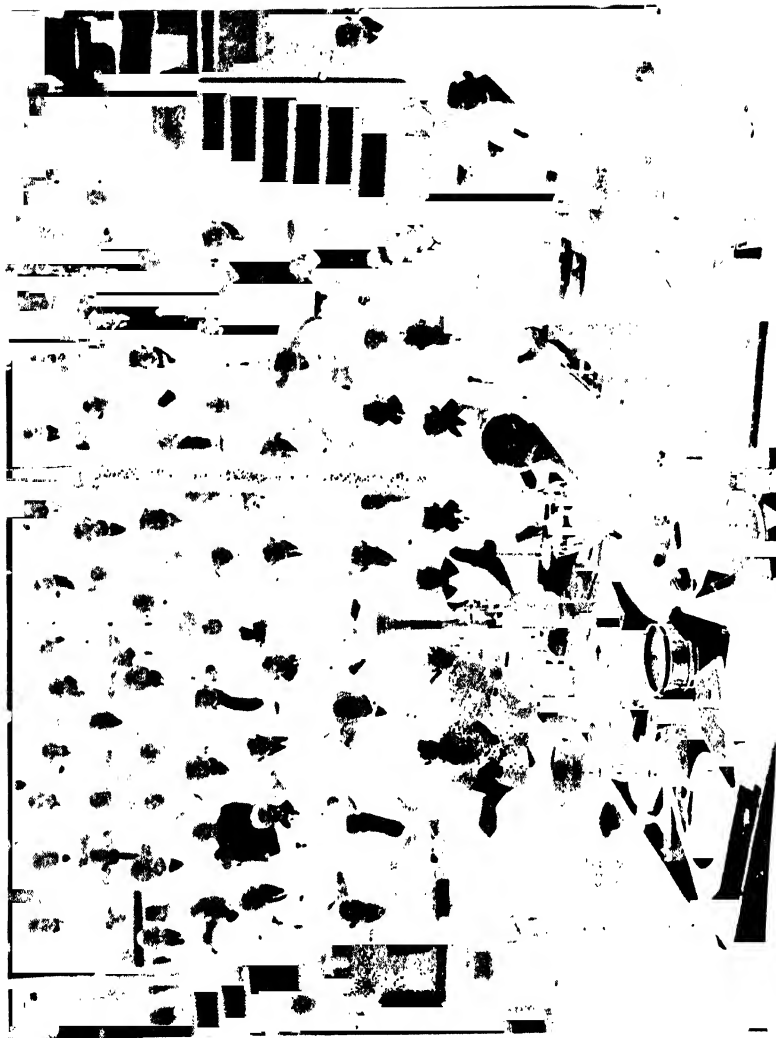
LATER YEARS

THOMPSON once laughingly said that his ideal of rest and retirement was "to be an old man in a garden, with a pipe." But those nearest to him, who witnessed his keen interest in life, and his indomitable energy, could never imagine him reaching such a culmination.

The last ten years seemed just as full of endeavour and achievement as any previous decade, in spite of the threads of joy and grief woven into them, and the added responsibilities.

In 1906 when Helen, his second daughter, was finishing her course for the Natural Science Tripos at Newnham College, Cambridge, the engagement and marriage of Sylvia, the eldest, to William Hanbury Aggs, a young barrister, one of a family who were fellow members of Westminster Meeting, broke up his home quartette.

During the next few months the loss of his sister Rachel Thompson, who had so often been one of the happy holiday company when they went abroad, and of his artist brother Thomas, were a great grief to him. He also had a long time of anxiety about his youngest brother, Dr. Tatham Thompson of Cardiff, who had to undergo a serious operation. He seemed to make a good recovery, but about three years later was attacked by a malignant disease from which he died in the spring of 1911, leaving his family of four children to finish their education, and to be established in careers. The two elder girls in succession became members of the family at "Morland" while studying in London. So, some years later, did Douglas, the youngest and only boy, *who was attending the Technical College, Finsbury, the session before his uncle's death.*



SILVANUS P. THOMPSON LECTURING TO A JUVENILE AUDIENCE AT THE ROYAL
INSTITUTION, CHRISTMAS 1910.

From a photograph taken for the "Daily Mirror."

The years during which Thompson was writing the Kelvin biography were almost entirely absorbed by it, and it was some months before he made up arrears, and was ready for fresh undertakings. He wrote in June 1910, in answer to Sir William Crookes, Secretary of the Royal Institution :

“I have quite made up my mind to assent to the proposition to give the next Christmas Lectures ; and, as I have had some talk with Dewar, I quite see your point about the change of outlook in the last sixty years, and will keep to one branch of physics.

“I think I shall have no difficulty in occupying the six lectures with *Sound*, if one may go rather far afield in some parts that border on optics and electricity. A suitable title seems not easy to find ; but that may wait.”

He later chose the title “Sounds Musical and Non-Musical.” Again he had crowded audiences of young and old, and again he delighted them all with his lively explanation of the innumerable experiments on sound, which he performed for them. It was hoped that the lectures might form a companion volume to *Light Visible and Invisible*, but he never succeeded in finding time to write it.

In June 1911 he wrote to Sir Oliver Lodge, whose birthday preceded his by a few days :

“O SEXAGENARIAN !

“I, who am about to follow in your train, salute you ! May the returns of the day of the year be yet many, and joyful, and may the years be golden, and their successive harvests of wisdom abundant. And may you never lack friends, old and young, to greet you as the years go by.

“Ever truly yours,

“SILVANUS P. T.”

To this Sir Oliver replied :

“MY DEAR SILVANUS,

“I am grateful for your good wishes and kind remembrance. I had quite a number of congratulatory epistles this year—but none more welcome than yours.

“Yours ever,

“O. J. L.”

Thompson was in joyful mood that summer, for he was much pleased with the engagement and marriage of his daughter Irene to T. Edmund Harvey, then Warden of Toynbee Hall. Son of an old school-fellow, William Harvey of Leeds, member of the Society of Friends, he shared several special interests with Thompson, among them the study of religion and the collection of old books.

Before going to the Alps in August, Thompson went with Professor Ferguson, F.R.S., to represent the Royal Society at Breslau University, which was celebrating its Tercentenary. He was guest of Professor O. Lummer, the translator of his *Light Visible and Invisible*, whose work on Optics he himself had translated into English. This celebration was considered very important by the Germans, and was presided over by the Crown Prince. It was a busy and fatiguing time for Thompson, as the following letter to his wife shows :

"Yesterday was so full, from morning to night, that I could not write a line. For the first time in my life I put on evening dress before breakfast at 8 a.m. Over this my doctor's gown, unique of its kind amidst hundreds of university costumes. We drove to the great hall of the University, where the function of presenting addresses and speech-making lasted till 2 p.m. Then lunch, then other receptions, then a formal dinner at 5 p.m. ! which lasted till 8 (the Crown Prince figuring at all these things). Then a garden party in the park, with 13,000 people (!) (?) present, and fireworks, and a fancy costume ball in the hall in the park . . . and so home to bed at 2 a.m. !! To-day (9 a.m.) we have just breakfasted—in evening dress—and my gown is ready. The ceremonies will last till 1 p.m."

Leaving Breslau the same evening, Thompson travelled across Europe and met his wife and Helen at Chamonix, glad to spend a few days in quiet before beginning his glacier climbing and sketching, and his informal discussions of the problems of the universe with the professional artist and with the professional theologian who sought his company under the evening stars night after night.

In the following year the Royal Society celebrated its

250th anniversary. Thompson was now serving on the Council for a second term (the first was in 1907), so had a busy time in connection with committees and arrangements. Delegates, accompanied by their wives and daughters, came from all over the world to present addresses of congratulation to the Society, and to share in the three days of ceremonies and festivities. Among the foreign delegates Thompson found many old friends; he had invited as his guests Sir William Barrett of Dublin, and Madame Curie of Paris, the discoverer of radium, who was, however, on the eve of the gathering prevented by home circumstances from coming to London. The ceremonies began with a service in Westminster Abbey, especially arranged for the occasion, followed by a reception at Windsor Castle, when the President, Sir Archibald Geikie, the Council, including Thompson, and the foreign delegates, were received in audience, and presented to the King and Queen. Afterwards they and all the Fellows of the Royal Society, with their wives and daughters, were invited to the royal garden party in the grounds of the Castle. The evening *soirée* at Burlington House on the following day was a very gorgeous one; the Fellows and delegates appeared in various robes and hoods which quite eclipsed even the most brilliant toilettes of the ladies.

From about this year onwards Thompson gave more time to the affairs of the Royal Society. He served on the International Committee among others. He was chairman of one which continued for several years, as it was entrusted with superintending the catalogue of the library, and had also the duty laid upon it of directing the preparation of the catalogue of scientific papers. On this he rendered invaluable service; the director of the work, Dr. Herbert McLeod, F.R.S., became seriously ill, and Thompson gave many hours of his spare time in trying to fill his place. He continued his services in this capacity until the time of his sudden illness, and afterwards a special acknowledgment and appreciation of his "ever courteous and tactful enthusiasm for work" was published in the preface to the subsequent volume of the catalogue.

Another Royal Society Committee for which Thompson acted as chairman was instituted to make enquiries as to the manufacture of optical glass in this country, a matter in which he had long been interested ; but it was only when the war broke out that others than the enthusiasts woke up to the necessity of taking active steps to encourage the manufacturers in this country.

Devotion to scientific work did not prevent Thompson from taking an interest in public affairs, and, although no politician, he sometimes, if only rarely, would express a strong opinion. At the time when society was very much disturbed by the controversy which was going on between the supporters and the opponents of the granting of the parliamentary franchise to women, and a certain party who demanded the vote had adopted violent tactics in striving to call attention to the grievances from which voteless women were suffering, Thompson showed the sympathy which he had always felt for the women's demand.

In 1912 a Bill to enfranchise a small proportion of women was before Parliament ; on the morning of the day when the second reading was to take place a long letter appeared in *The Times* from a London physician, trying to prove that women were too hysterical, and too unbalanced as a sex to be trusted with the power of the vote, and arguing that their interests were quite fully and sufficiently considered by their male relations.

The letter caused a storm of indignation among a great many women engaged in philanthropic and public work, but it came very conveniently for the opposers of the Bill in the House of Commons, who did not fail to quote its arguments in the debate. The Bill was lost. Next morning there appeared in *The Times* the following letter from Thompson :

“ SIR,

“ Sir Almroth Wright's trenchant letter would carry more weight if it did not ignore or deny the one thing which has made into advocates of the suffrage many women who are bitterly opposed to the deplorable tactics of the Pankhurst rabble. That thing is the continued violation by law, and under the aegis of law, of the very ' covenant ' which

Sir Almroth Wright declares to be within the frontiers of civilisation ! There is, in fact, a continued failure, both of the law as administered and of the unwritten code of social law, to put an end to crimes against the person of women. The absurdly low sentences against men convicted of assault, the utterly inadequate protection against seduction, the tolerance by society of a double standard of morals in the premarital state, the advocacy, even by an eminent Judge, of an inequality between man and woman in the laws of divorce—these are the things which give the lie to Sir Almroth Wright's complacent assumption, that under this covenant a full half of the programme of Christianity has been realised.

“ Half of the facts having been conveniently omitted, his argument from physiology is at least half a fallacy ; and even a fallacy need not degenerate into a tirade.”

Thompson received letters of thanks from several women, including Mrs. Hertha Ayrton, Lady Barlow, and some of the women physicians and surgeons, and earned the gratitude of many of the younger university women, including his own daughters Helen and Dorothea.

During these later years Thompson received several marks of recognition from academic bodies, and was always frankly pleased and interested by such honours. In 1909 the newly constituted University of Birmingham took the step of conferring honorary degrees upon a number of distinguished men and women. Thompson was the recipient of the Hon. LL.D., and was presented to the Vice-Chancellor by Principal Sir Oliver Lodge in the following words :

“ The Principal of the Finsbury Technical College, London, an able and renowned electrician, is the author of many standard treatises, highly valued by electrical engineers, and is exceptionally familiar with scientific history. Brilliant as a lecturer and expositor, skilled as an artistic draughtsman, clear-headed as a thinker, and learned as an historian of science, he has maintained a wide interest in many departments of study, and it is with pleasure that I present a friend well known to many of us, Silvanus Phillips Thompson.”

Three years later he had the gratification of revisiting the old College at Bristol, now constituted a University, to

receive an honorary degree of Doctor of Science. That he was still remembered there was evidenced by the applause with which he was greeted when he went up for presentation.

In June 1913 Thompson wrote to T. Bailey Saunders :

“ DEAR T. B. S.,

“ It is my turn to ask for succour. I received to-day a marvellous Latin diploma, informing me that the Accademia delle Scienze at Bologna (oldest of the Italian Academies) had elected me as a Foreign Member.

“ I must write an acknowledgment. If it had been in Italian I would have vamped up some elegant nonsense by way of gracious thanks for election to so distinguished a body. But it is in Latin ! Had I an hour, and brain activity enough, and an inspiration, I might by duly thumbing a dictionary concoct at best a lame and clumsy attempt. The inspiration has come—‘ Ask your best friend among the scholars to frame you a reply.’ So therefore, *amicorum intime*, do me the honour to excoct a gorgeous epistle of thanks suitable to the occasion.

“ To drag in references to the phosphorescence of the Bologna stone, shining in darkness, or to the marvellous consequences of Galvani’s observations of frogs’ legs spasmodically kicking were perhaps redundant.

“ But the Accademia is so famous a body—*vide* its history in *Minerva*—that the honour it has accorded to my unworthy self requires some unusual response. I shall find my head swelling if I cannot compass a little letting of blood—by deputy !

“ And your petitioner will ever pray !

“ Salaams,

“ S. P. T.”

Foreign travel occupied a great part of Thompson’s leisure in 1913. Early in March he had to spend a few days in Cologne, as in 1912, in connection with the Electrotechnical Commission. He wrote from the Dom-Hotel to his wife :

“ Professor Budde is expected here in an hour’s time. I have had a delightful walk by the Rhine since breakfast—in brilliant sunshine, and with a frost-nip in the air. I have just been lunching in the self-same dining-room where, many years ago, we brought four hungry little girls, whose

eyes glistened and opened wide at the gorgeous beefsteak *garni* which was served to us, when we lunched here on our way to the Schwarzwald. Those are happy memories."

Easter vacation was spent in Florence, when he and his wife stayed with her sister, Mrs. J. W. Cruickshank, and her husband in their villa on the hill near San Miniato. Thompson spent a good many afternoons in the ancient libraries among his favourite manuscripts and books. A few days were also devoted to the art treasures of Siena, and a flying visit was paid to his friend Professor Righi at Bologna.

A holiday in Switzerland and Savoy, followed by a visit to Berlin to attend the Conference of the International Electrotechnical Commission, completed his travels that year.

About this time Thompson felt obliged to decline the offer of an important, but rather arduous and not very remunerative piece of work, and received the following from the scientific friend of many years, through whom it had come :

"I was greatly disappointed when reading your letter, but I quite understand. . . . You have done great work in your life, and not merely in electricity, not merely in physical science, but your faculties have been so cultivated that you have sent out sympathetic tentacles in all directions and give comfort to others without seeming to exert yourself. You must be very proud of your career, and you will leave your daughters what is much more important than thousands of pounds. To me personally your conduct has been of great value on countless occasions."

As may have been gathered from previous pages, Thompson had no very great admiration for the philosophical teaching of Herbert Spencer, but, as a psychologist and biologist, he regarded him as a great man. Therefore, when he was invited in 1914 to go down to St. Leonards to unveil a Memorial to Herbert Spencer, who had lived and worked there during the last few years of his life, he willingly consented. The ceremony took place whilst a Pageant of Heroes was being held at Hastings. Thompson gave an

address, dealing with the different fields of thought covered by the writings of Spencer, whom he claimed as *Hero as Thinker*, equally to be recognised by the side of the poets and dramatists, and the more familiar men of action.

In the latter part of the address he dealt sympathetically with Spencer's ideas of social reform, and quoted from his essay on "The Rebarbarisation of England," written to show the social after-effects of the Boer War. He closed by saying that the hero whom they were commemorating was one "who could stand in the face of a crowd, and say an unpopular thing which he believed to be right; one who loved truth for its own sake, and who never hesitated to stand for truth, when he felt it to be in place."

After a busy session, and the fulfilment of many engagements, the prospect of rest and holiday was eagerly looked forward to by Thompson this year, and he had planned to go to a new field for sketching and painting.

About the middle of July, he and his wife started for Lake Misurina, travelling through Switzerland and via the Brenner Pass into Tirol. Then, crossing the frontier, they settled down in an hotel on the banks of the lake surrounded by the Dolomites of the Italian Alps.

He had begun some promising paintings of the mountains from various points of view, when quite unexpectedly his holiday was interrupted by the news of the declaration by Austria of war against Serbia. A few days before a number of Austrians in the hotel had taken their departure, saying that they feared that war was coming, for the tone of the Austrian newspapers was ominous. But, being over the Pass, and actually in Italy, Thompson did not realise the danger, and they were still intending to return to Switzerland through the Trentino, when on August 1st a telegram brought the news that Germany was mobilising against Russia and France.

At once a stampede began among the visitors of all nationalities, all seeking to get away from the frontier. On Sunday some English friends of the Thompsons and most of the Germans managed to secure carriages, and went off down the Pass into Austria.

On August 2nd Thompson wrote to the Registrar of the College :

“ We are avoiding Austria by going down into Italy, and back into Switzerland through the Gotthard Tunnel. We expect to reach Hotel Belvedere, Furka Pass, Switzerland, on August 5th, and to stay there three or four days. After that, Hotel Victoria, Brieg, till about August 12th.”

This did not reach its destination until August 26th, for all international postal communication seemed to come to a dead stop for two or three weeks. Thompson was anxious to communicate, too, with his daughter Helen, who had gone to the Oberland on a walking expedition, in company with a college friend ; they had arranged to meet at Brieg on August 12th. That Sunday was spent in walking, with minds full of anxiety and dismay, round the beautiful Lake Misurina, the great dread being lest Italy should come into the war on the side of her former Allies.

Early on the Monday they managed to secure a carriage and horses for the long drive down to the railway line. The drive through Cadore, the country of Titian, was glorious. A year later the same places were the scenes of most terrible battles, and every village was reduced to a ruin.

At Belluno station they found themselves in a throng of refugees from the Tirol, Americans, French, Italians.

Arriving at Milan, next day, they found the Swiss frontier closed to all except Swiss people, so Thompson had to make up his mind to stay in Italy until some other way of returning to England should open out. The shock to him of hearing that England had declared war against Germany was very great, though, after hearing of the German invasion of Belgium, he admitted that there seemed no other course open to the Government. He was also very anxious about Helen, telegraphing to friends in Switzerland and in England to try to find out where she was ; at length in ten days a reply reached him that she was safe. But he never quite recovered from the strain ; happily in Milan he had some kind friends amongst the electrical engineers, who assisted him in many ways.

The plight of friendless and stranded tourists, unable to change notes and cheques, was very much worse, and the various consular offices were besieged. About the middle of August the British Embassy, acting with the Consuls in various towns, chartered a White Star liner *The Cretic*, which was lying in Genoa harbour. All intending passengers had to prove their British nationality to the Consul at Genoa before being allowed to sail. This caused much delay, and a number of Englishmen, including Thompson, formed a committee to help the Consul with this duty. Spite of all, some very dubious characters got on board, and thefts were frequent during the voyage.

All passengers had to pay first class fare, but the very poor went free. There were over 700 on board, and only cabins for 400. The rest had to go down into the emigrants' quarters. Women and children were allotted cabins first, then a few of the older men. The heat in the Mediterranean was intense. In writing to his sister, Mrs. Brockbank, after their return Thompson described the voyage :

“ We had a scratch crew of Lascars on board, so the passengers formed a night patrol among themselves. We had only half the usual complement of stewards—and not a single stewardess on board. The meals the first day were a kind of free fight, after that they settled down. The food was unappetising, and all the plates and cups and knives were dirty.

“ Happily, and it was the one saving thing—the weather was superb. Even the Bay of Biscay was like an oiled mill-pond. Janie was not ill at all, and only one day did she stay on deck for meals. We stopped three hours in Gibraltar harbour, and had no adventures with cruisers, though one night we were ordered to put the lights out.

“ We had quite a large number of acquaintances on board, chiefly people whom we had met at Alpine resorts in Switzerland in former years.

“ So beyond the physical discomforts of dirt, and vermin, and overcrowding, there was not much to complain of, beyond general lack of management of the ship. But neither of us would wish to repeat the experience of being refugees again. There were many poor creatures worse off than we, who had no money, who had lost their baggage, or

who had no friends to go to. Their miseries were reflected in the general state of depression, until the last two days as we neared England. Had the weather been stormy the state of things (during these nine days) would have been truly dreadful."

The captain was sailing under sealed orders, and it was not until the last day that the passengers knew that they were to be landed at Liverpool. People in England knew, however, and a list of those on board had been published in the papers. So, on landing, the Thompsons received a warm welcome from the Birkenhead Thompson cousins, and their own two daughters Sylvia and Dorothea, who had come away from the East Coast and brought the little granddaughter Gulielma Mary Aggs to safer quarters in the West.

Sylvia and Gulielma came back with them to "Morland," but they had another week of anxious waiting until Helen and her friends reached London on August 28th, having come across France to Dieppe in special trains run by the Swiss and French Governments to bring back refugees. At that time the Germans seemed to be sweeping on to Boulogne.

Every week brought increasing perplexity as to the future carrying on of the College, as numbers of the young assistants and older students volunteered, or applied for commissions in the new armies which were being formed.

Thompson had no heart for painting now, brushes and paints were laid aside, and never taken up again, though one of his 1913 glacier pictures appeared on the walls of the Royal Academy in 1915.

Soon after College opened the young son of Professor Omer De Bast of Liège had to flee to England, and came with a letter to Thompson from his father. The boy, Yves, was anxious to go on with his studies in science, in preparation for a medical career. Thompson invited him to live with him, and obtained a free place for him at University College, where he studied for a session, and then was called up to be trained for military service in the Belgian army.

Thompson became much attached to him, and Yves,

reciprocating the affection, always afterwards spoke of him as "mon seconde père."

Thompson gave this autumn a course of university lectures on Magnetism at University College. He wrote in December to his wife :

"My third and last University Lecture went off very well. I think the audience was a little larger than at the previous two. Carey Foster came up to town for it. I finished a little review of the *Life of Lubbock* for *The Friend* last night after my evening lecture. It is quite interesting, though the author has no style.

"At the College Committee on Monday afternoon the members present were very gloomy about the prospects of the Institute in this crisis. They say that several of the Companies have been very hard hit. About your question in your last letter, the new Thermophone is interesting as a piece of scientific apparatus ; but it is not a very practical thing. I had a visit to-day at College from a post office official—a very courteous one—to look for my (non-existent) wireless installation, which he had orders to seal up ! He did not propose to capture any of my coils or Leyden Jars !"

One of Thompson's scientific friends did not get off so lightly over the question of his wireless installations ; he was attacked in one of the spy-hunting newspapers, and Thompson wrote a vigorous letter to the press in his defence, explaining the real facts of the case.

The Christmas of 1914 was a sad one for Thompson, for private grief at the death of his favourite sister, Marie Brockbank, after a few days' illness, was added to the public sorrow, and to depression caused by the growth of hatred and war-fever around him.

Next spring brought increasingly hard work at the College, as his colleague, Professor Meldola, who had been overworking very much at chemical advisory work for the Government, was attacked by serious illness and had to undergo an operation. Also a considerable part of the laboratory space of the College was commandeered for army research work purposes.

Professor Meldola recovered, and was able to act as chairman to the research department of British Dyes, in which three of his former students at the Technical College took prominent part, Dr. C. T. Morgan, F.R.S., Professor W. J. Pope, F.R.S., and Dr. M. O. Forster, F.R.S. The last-named had helped to carry on the chemical work at College during Professor Meldola's illness. This part played by college students was a gratification to Thompson.

As the war progressed the increasing hatred shown in this country towards Germans was a great trouble to him, and utterances by the clergy with regard to this led him to make both public and private protests.

One of the latter led to a correspondence with his old friend, Canon Wilson of Worcester, which was quite friendly, though he failed to convince him. He also wrote to a Swedish paper, *Svenska Dagbladet*, which was making enquiries in European countries as to the effect of the war on international co-operation for progress in science. Thompson, who was on the Nobel prize committee, expressed his opinion that :

“Men of good-will in all nations (including nations now combatant) will see to it that the evil passions of jealousy, distrust, domination, and hate shall not be permitted to interfere with progress and civilisation. These passions are the causes of war, not its consequences. When this war is ended those who continue to foster these passions will be the enemies of mankind and of progress, in whatever nation they are found.”

Towards the end of the year the Council of the Institution of Electrical Engineers, urged thereto by some of its members, tried to bring forward a resolution expelling all members of enemy origin or nationality. Knowing how much electrical engineering owed to German inventions and improvements, Thompson vigorously opposed this. He succeeded so far that, when the resolution was put before the special general meeting in March 1916, there was a considerable divergence of opinion, and finally, after an adjourned meeting, it was decided not to expel members

of enemy origin who had been naturalised, and were approved by the Council.

Although led by his convictions into opposition to many of his oldest friends, Thompson's views were always sympathetically received, being, as many of them felt, and said, in harmony with his actions and conduct throughout life.

During the summer of that year Dorothea, who had become very seriously affected by the asthma trouble from which she suffered, was ordered to take a long voyage, as the only hope of checking the disease. Early in August she started with her sister Helen for New Zealand via the Cape.

It was just at the time that the submarines were beginning to attack steamers, and Thompson had an anxious time until a cable from Cape Town announced their safety; and much improved health for the invalid.

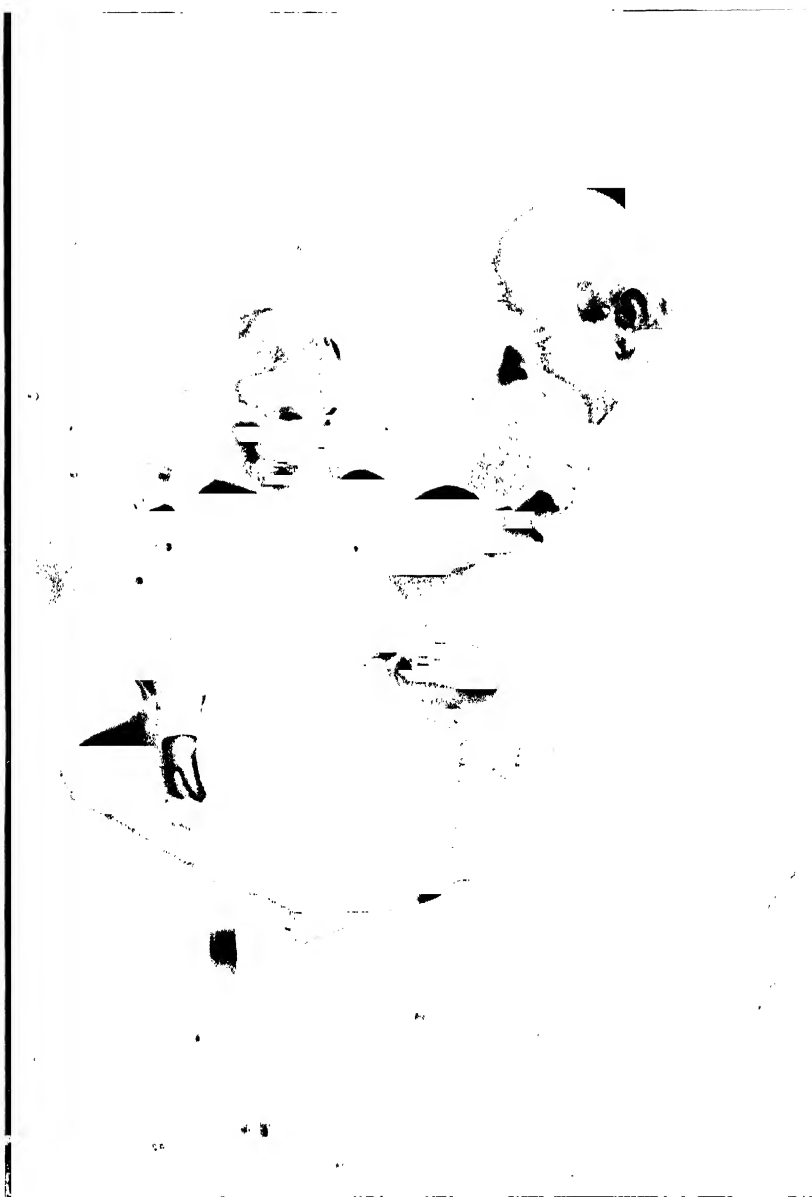
Not long after, the sudden death of Professor Raphael Meldola, his colleague of thirty years, gave him a great shock. His other colleague Professor Margetson, who had not long succeeded Professor E. G. Coker, was not sufficiently experienced in the work of the Technical College to be able to help and counsel him as Professor Meldola had done.

This loss, supervening on his hard work, made him seriously ill. He consulted a physician, who warned him that he must take great care, and rest more, a counsel which it was impossible for him to follow. The work at College, however, through the circumstances of the war, was to some extent lightened in that the Evening Classes Department had to be closed in consequence of the air raids.

Christmas was spent quietly at home, and his eldest daughter brought her two little children, Gulielma and Silvanus Hanbury Aggs, to cheer up the contracted circle.

One of Thompson's favourite poems had long been Victor Hugo's "*L'Art d'être grandpère.*" He delighted in its descriptions of the little "*Georges et Jeanne,*" and he now greatly enjoyed practising that art himself.

Writing at the close of the year to his old friend Conrad Cooke, he says: "I have my two grandchildren staying with me: the girl aged three and a half, the boy nine months.



SILVANUS P. THOMPSON AND HIS FIRST GRANDCHILD, GUILIELMA MARY
AGGS.

From a photograph taken by T. Edmond-Bull in 1914

They are a perfect delight, and most entertaining companions." In the same letter he says :

"In spite of all the war wearinesses, and overwork that it entails, I am finding every now and then odd moments to rewrite my book on the Electro-magnet.

"I have now been eight years over it ; and it may take a year or two more."

After the safe return of Helen from New Zealand, where she had left her sister in much improved health, Thompson accompanied Sylvia and the grandchildren on their return to Amersham, where he spent a quiet week.

During the next three months, while still actively going about his duties, his friends noticed, with growing anxiety, how tired and exhausted he often looked.

The appointment to the Chair of Chemistry of Dr. G. T. Morgan, who had been trained in the Finsbury tradition, was a help to him, but many details had of course to be readjusted and arranged.

In March, however, he found time to prepare and deliver a Friday evening discourse at the Royal Institution, on the phenomena of the Electric Corona, which was given with his usual ease and richly illustrated by interesting experiments.

Owing to the darkening of London streets, the Friday gatherings of members now took place before seven o'clock, and were in consequence shorn of many of their attractions, and often very small.

For several months another of Thompson's old friends, Sir William Ramsay, had been gradually going down into the valley of the shadow of death, suffering from a painful illness, from which there was no hope of recovery. Thompson visited him several times out at High Wycombe, and after the last occasion Lady Ramsay wrote :

"I have two of the very kindest letters I ever had to thank you for. Your visit was a real treat to my husband, and later on it would be really kind to repeat it. You brought an atmosphere of peace and brightness, and it remained. Perhaps you might telephone in case it was one

of my husband's bad days, and it would be well to avoid that."

Soon after this Thompson and his wife went for three weeks to Bath. He always enjoyed this old and beautiful city, and the fine country surrounding it. The visit seemed to bring him much benefit, and he returned looking brisk and fresh to take up his tasks again.

The passing of the Compulsory Military Service Acts brought great and special anxieties to members of the Society of Friends. Although a conscience clause had been put into the Act, yet it was left to the discretion of tribunals, often ignorant, and militarist in spirit, to decide whether a man was "conscientious" or not, with the consequence that very soon well-known Quakers were being court-martialled for refusing to obey military orders, and older men who published protests against this also became liable to trial under the Defence of the Realm Act.

The Yearly Meeting in May was a time of great anxiety to the older Friends, and Thompson took his share in the deliberations. On the last Sunday of the month he was appointed to give a special address at Westminster Meeting on "What the Society of Friends stands for." He spoke calmly and eloquently for an hour, without once referring to his notes, and his address made a deep impression upon the congregation.

The lowering to eighteen of the age of those who came under the Military Service Acts seemed to bring consequences which were very hard for Thompson to bear, both for the students themselves, and because of the needs of the country for trained chemists and engineers.

At eighteen the students were just finishing their second year's course, and for many it meant the ruin of their scientific career to be interrupted then. This was especially true in the case of the chemists, and by great effort Thompson succeeded in getting exemption for some of them through the Education Office.

But grief and worry and overwork told on him severely. One Saturday morning he went to the College to try and

arrange for the exemption of one of the assistants. He was disappointed in his efforts, and that evening seemed very tired and exhausted.

Early, on Sunday morning he had an attack of cerebral hemorrhage, which rapidly rendered him unconscious, and he passed peacefully away on Monday night, June 12th, a week before his sixty-fifth birthday.

After cremation, his ashes were placed in the burial-ground near the Old Friends' Meeting House, at Jordans, Buckinghamshire, which he had sometimes visited and admired.

A memorial Meeting was held at Westminster Meeting House in St. Martin's Lane. It was crowded by fellow members of the congregation, large numbers of old students, and many scientific men who represented all the Societies and other bodies with which he had been connected.

There were, besides, many other representatives of literature, art, and science, and many old friends.

The Meeting was solemn and reverent. Lines from Browning quoted by Edward Grubb, an old friend of him whom they mourned, seemed very appropriate :

“ One who never turned his back, but marched breast forward,
Never doubted clouds would break,
Never dreamed, though right were worsted, wrong would triumph,
Held we fall to rise, are baffled to fight better,
Sleep to wake.”

APPENDIX

LIST OF HONOURS AND DEGREES, ETC.

- 1867 Matriculation in the University of London.
- 1869 Bachelor of Arts, London.
- 1875 Fellow of Royal Astronomical Society.
- 1875 Bachelor of Science, London.
- 1875 Member of Physical Society of London.
- 1878 Doctor of Science, London.
- 1882 Member of Society of Telegraph Engineers and Electricians.
- 1883 Honorary Member of Physical Society of Frankfurt-am-M.
- 1886 Member of the National Electric Light Association (U.S.A.).
- 1886 Member of the Royal Institution of Great Britain.
- 1890 Member of the "Sette of Odd Volumes."
- 1890 President of the Junior Institution of Engineers.
- 1890 Member of the Council of the Société de Physique, Paris.
- 1890 Vice-President of the Physical Society, London.
- 1890 Hon. Vice-President of the Electrical Exhibition, Frankfurt.
- 1891 Fellow of the Royal Society.
- 1891 Member of the Administrative Committee of the Société Internationale des Électriciens.
- 1894 Foreign Member of the Royal Academy of Science, Stockholm.
- 1894 Hon. Degree of Doctor of Medicine and Surgery, University of Königsberg.
- 1897 Hon. Member of Yorkshire Philosophical Society.
- 1897 First President of the Roentgen Society, London.
- 1898 Foreign Member of the Associazione Elettrotecnica Italiana.
- 1899 Diploma de Benemerenzia, International Electrical Congress, Como.
- 1899 President of the Institute of Electrical Engineers.

- 1899 Freeman of the City of London.
- 1900 Elected Member of the Senate of the University of London.
- 1900 Honorary Member of the Roentgen Society.
- 1901-2 President of the Physical Society of London.
- 1902 Member of the American Philosophical Society, Philadelphia.
- 1902 Foreign Member of the Société Néerlandaise des Sciences.
- 1902 President of the Hampstead Scientific Society.
- 1902 President of the Friends' Guild of Teachers.
- 1903 Honorary Member of the Optical Society.
- 1904 Honorary Fellow of the Royal Microscopical Society.
- 1905 President of the Optical Society.
- 1905 President of the "Sette of Odd Volumes."
- 1905 Honorary Member (number limited) of The Essex Field Club.
- 1907 Member of the Council of the Royal Society.
- 1907 President of the South-Eastern Union of Scientific Societies.
- 1907 Member of the Athenæum Club, elected under Rule II.
- 1909 First President of the Society of Illuminating Engineering.
- 1909 Honorary Degree LL.D., University of Birmingham.
- 1911 Honorary Member of the Friends' Guild of Teachers.
- 1912 President of the Optical Convention (Second).
- 1912 Honorary Degree D.Sc., University of Bristol.
- 1913 Foreign Member, Accademia delle Scienze, Bologna.
- 1914 Honorary Member of the American Institute of Electrical Engineers.
- 1914 Vice-President of the Institute of Ophthalmic Opticians.
- Vice-President of the Selborne Society.

LIST OF PRINTED BOOKS

- 1879 Technical Education.
- 1881 Elementary Lessons in Electricity and Magnetism.
- 1883 Life of Philipp Reis, Inventor of the Telephone.
- 1884 Dynamo-electric Machinery.
- 1890 Translation of Guillemin's Physique (Electricity).
- 1891 The Electromagnet and Electromagnetic Mechanisms.
- 1895 Polyphase Electric Currents.
- 1896 Light Visible and Invisible.
- 1898 Life of Faraday.

- 1900 Photographic Optics. From the German of O. Lummer.
- 1903 Design of Dynamos.
- 1906 The Manufacture of Light.
- 1910 Life of Lord Kelvin.
- 1910 Calculus made Easy (by F.R.S.).
- 1912 Translation of Huyghens' Treatise on Light.
- 1915 The Quest for Truth.
- 1918 (posthumous) A Not Impossible Religion.

PRIVATELY PRINTED

- 1891 William Sturgeon the Electrician.
- 1891 Gilbert of Colchester: An Elizabethan Magnetizer.
(Opusculum of "Sette of Odd Volumes")
- 1893 The Magick Mirrour of Old Japan (Opusculum, O.V.).
- 1898 Reprint (with preface), Two Tracts on Electricity and
Magnetism by the Hon. Robert Boyle (Opusculum,
O.V.).
- 1900 Notes on the De Magnete of Gilbert, to accompany the
Gilbert Club translation.
- 1902 Translation of the Epistola de Magnete of Petrus Pere-
grinus.
- 1903 The Family and Arms of Gilbert of Colchester.
- 1903 Gilbert: Physician.
- 1903 Gilbert of Colchester, Father of Electrical Science.
- 1903 William Gilbert and Terrestrial Magnetism in the Time of
Queen Elizabeth.
- 1905 The Pied Piper of Hamelin (Opusculum, O.V.).

ADDRESSES AND COMMUNICATIONS TO SOCIETIES, ETC.

1876

On Some Phenomena of Induced Electric Sparks (*Phil. Mag.,
Proc. Physical Soc.*).

1877

On the Chromatic Aberration of the Eye in Relation to the
Perception of Distance (*Phil. Mag.*).

Note on a Curious Effect of the Absorption of Light (*Phil. Mag.*).

On Interference Fringes within the Nicol Prism (*Proc. Physical
Soc.*).

- On an Improved Lantern Galvanoscope (Brit. Assoc.).
 On the Relative Apparent Brightness in Monocular and Bino-
 • cular Vision (Brit. Assoc.).
 Some New Optical Illusions (Brit. Assoc.).
 Sur les Figures Stroboscopiques (*Bull. Soc. Française de Physique*).
 Binaural Audition, Part I (*Phil. Mag.*).
 Methods of Physical Science (Introductory Address, Bristol
 • University College).

1878

- On Technical Education. Where it should be given (Social
 Science Congress).
 • On Permanent Plateau's Films (*Phil. Mag., Proc. Physical
 • Soc.*).
 Magnetic Figures illustrating Electrodynanic Relations (*Phil.
 Mag., Proc. Physical Soc.*).
 New Magnetic Figures (Brit. Assoc.).
 On Certain Phenomena accompanying Rainbows (Brit. Assoc.,
Phil. Mag.).
 Binaural Audition, Part II (Brit. Assoc., *Phil. Mag.*).
 L'Audition Binaurculaire (Assoc. Française par l'Avancement
 des Sciences).
 On Unilateral Conductivity in Tourmaline Crystals (in con-
 junction with Dr. O. J. Lodge) (Brit. Assoc., *Phil. Mag.*).

1879

- Apprenticeship Scientific and Unscientific (*Jour. Soc. of Arts*).
 Suggested Scheme for a Central Institution for Technical Educa-
 tion.
 On the Retardation of Phase Vibrations transmitted by Tele-
 phone (Brit. Assoc.).
 Notes from the Physical Laboratory of University College,
 Bristol (*Phil. Mag.*).
 The Pseudophone (*Phil. Mag.*).
 The Action of Magnets on Mobile Conductors of Current (*Phil.
 Mag.*).
 • A Study in Magnetism (*Nature*).
 On a Law of Retinal Activity (Brit. Assoc., Section D).

1880

- Apprenticeship of the Future (*Contemporary Review*, Sept.).
 Apprenticeship Schools in France.

- Lecture Experiments in Acoustics (*Phil. Mag.*).
 Optical Illusions of Motion (*Brain*, October).
 The First Telephone (Bristol Naturalists' Soc.).
 Science Readings for the Magic Lantern in three parts. Magnetism and Electricity, Telephone, Microphone and Phonograph, Electric Light and New Inventions.
 On the Electric Conductivity and Dichroic Absorption of Tourmaline (Brit. Assoc.).

1881

- The Storage of Electricity (*Jour. of Soc. of Arts*).
 Binaural Audition, Part III (*Phil. Mag.*).
 On the Conservation of Electricity and the Absolute Scale of Electric Potential (*Phil. Mag.*).
 On Volta-Electric Inversion (Brit. Assoc.).
 On the Opacity of Tourmaline Crystals (*Phil. Mag.*).
 On a New Polarising Prism (Brit. Assoc., *Phil. Mag.*, *Jour. de Physique* ; *Centralzeitung f. Optik. u. Mech.*, 1882).
 Notes on the Construction of the Photophone (*Phil. Mag.*).
 Labour and Science (*Jour. of National Chamber of Trade*).

1882

- How can Technical Education be best associated with Primary Schools ? (Social Science Congress).
 Dynamo-Electric Machinery. Cantor Lectures (*Jour. Soc. of Arts*).
 On the Electric Resistance of Carbon under Pressure (*Phil. Mag.*).
 The Age of Electricity. Introductory Lecture, University College, Bristol.
 A New Phonautograph.
 The Beats of Mistuned Consonance (*Phil. Mag.*).
 On the Function of Two Ears in the Perception of Space (*Phil. Mag.*).

1883

- Remarks on Contact Resistance (*Jour. Soc. Telegraph Engineers and Electricians*).
 On the Graphic Representation of the Law of Efficiency of an Electric Motor (*Phil. Mag.*).
 Recent Researches on Dynamo-electric Generators (*Proc. Bristol Naturalist Soc.*).
 Polarising Prisms (*Phil. Mag.* ; *English Mechanic*, 962 ; *Jour. Roy. Microsc. Soc.*).
 Experiments on Bolometry (Brit. Assoc.).

1884

Recent Progress in Dynamo-Electric Machinery (*Jour. Soc. of Arts*).

Note on the Theory of the Magnetic Balance of Hughes (*Proc. Roy. Soc.*).

On a Modified Resistance Balance (*Phil. Mag.*).

On the Adjustment of Resistance Coils (*Phil. Mag.*).

On a New Insulating Support (*Phil. Mag.*).

Communication on Contact Pressure (*Jour. Soc. Telegraph Engineers and Electricians*).

1885

Lectures on Waves [Juvenile Lectures] (*Jour. Soc. of Arts*).

Apparatus for the Automatic Extinction of Fires (*Jour. Soc. of Arts*).

1886

On Maintaining Tuning-forks by Electricity (*Phil. Mag.*).

Law of the Electromagnet and the Dynamo (*Phil. Mag.*).

Further Notes on the Formulæ of the Electromagnet and the Dynamo (*Phil. Mag.*).

German Translation of the above by Exner in *Repertorium der Physik*.

Notes on some New Polarising Prisms (*Jour. of Roy. Micros. Soc., Phil. Mag.*).

1887

The Present Position of the Technical Instruction Question (Conference on T. I., London, Nov. 1887).

Die Neuesten Fortschritte in Dynamo-elektrischen Maschinen (*Jahrbuch f. Elektrotechnik*).

Note on the Electrodeposition of Alloys (*Proc. Roy. Soc.*).

On an Arc-lamp suitable for use with the Duboscq Lantern (*Phil. Mag.*).

Twin Prisms for Polarimeters (*Proc. Mag.*).

1888

The Development of the Mercurial Air-pump (*Jour. Soc. of Arts*).

On the Formulæ for the Lighting Power of Magnets (*Phil. Mag.*).

Note on the Conditions of Self-excitation in a Dynamo Machine (*Phil. Mag.*).

Some Experiments on Electro-magnetic Action (*Electrician*, Sept.).

- On Electrical Theory (*Electrician*, Nov.)
 The Influence Machine from 1788-1888 (*Jour. Soc. Telegraph Engineers and Electricians*).
 On a Modified Water-dropping Influence Machine (*Phil. Mag.*).
 Note on Continuous Current Transformers (*Phil. Mag.*). •
 On the Price of the Factor of Safety in the Materials for Lightning-rods (*Phil. Mag.*).

1889

- Arc-lamps and their Mechanism (*Jour. Soc. of Arts*).
 On the Magnetic Action of Displacement Currents in a Dielectric (*Proc. Roy. Soc.*).
 Note on Polarising Apparatus for the Microscope (*Jour. Roy. Micros. Soc.*).
 Notes on Geometrical Optics, Part I (*Phil. Mag.*).
 Optical Torque [Friday Discourse] (Royal Institution).

1890

- The Organisation of Secondary and Technical Education in London (*Jour. Soc. of Arts*).
 The Electromagnet. Cantor Lectures (*Jour. Soc. of Arts*).
 The Physical Foundation of Music. Discourse (Royal Institution).
 Electro-magnetic Mechanisms. Presidential Address (Junior Engineering Soc.).

1891

- The Measurement of Lenses (*Jour. Soc. of Arts*).
 Das Neue Gebiet der Alternierende Ströme. Vortrag. (*Frankfurt-am-M. : Bericht des Internationalen Elektrotechniker-Kongresses*).
 Electricity in Mining. Lecture to Working Men (Brit. Assoc.).
 On the Use of Fluor-spar in Optical Instruments (*Phil. Mag.*).
 On the Focometry of Lenses and Lens-combinations (*Proc. Roy. Soc.*).
 On Galvano-hysteresis. Prelim. Note (*Proc. Roy. Soc.*).

1892

- On the Physics of the Voltaic Arc (Brit. Assoc.).

1893

- Practical Electrical Problems at Chicago (*Jour. Soc. of Arts*).
 Ocean Telephony. Pamphlet.
 Some Notes on Photometry (*Phil. Mag., Proc. Physical Soc.*)

1894

Notes on Rotatory Field Motors (*Electrician*).

On the Design and Winding of Alternate-current Electromagnets (*Phil. Mag.*).

Electromagnets. S. P. T. and Miles Walker (*Phil. Mag.*).

Transformations of Electric Currents. Discourse (Royal Institution).

1895

The Arc Light. Cantor Lectures (*Jour. Soc. of Arts*).

Mirrors of Magnetism. S. P. T. and Miles Walker (*Phil. Mag.*).

Note on a Neglected Experiment of Ampère (*Phil. Mag.*).

Note on the Cause of the Differences in Lichtenberg's Dust Figures. Preliminary Note (*Proc. Roy. Soc.*).

. 1896

The Making of a Great University for London (*Jour. Soc. of Arts*).

Some Experiments with Roentgen's Rays (*Phil. Mag.*).

Electric Shadows and Luminescence. Discourse (Royal Institution).

On Hyperphosphorescence (*Phil. Mag., Proc. Roy. Soc.*).

Luminescence (Oxford University Jun. Sc. Club).

More X-ray Myths (*Electrician*).

Kathode, X-, and Becquerel Rays (Brit. Assoc.).

Hyperphosphorescence (Brit. Assoc.).

1897

Reforms in the Organisation of Technical Education (*Jour. Soc. of Arts*).

Presidential Address to the Roentgen Society.

Cathode Rays and Some Analogous Rays (*Proc. Roy. Soc. Phil. Trans. Roy. Soc.*, 1898).

Peter Short, Printer, and his Marks (Bibliographical Soc.).

1898

Telegraphy Across Space [Silver Medal] (*Jour. Soc. of Arts*).

Electric Traction by Surface Contacts. S. P. T. and Miles Walker (Brit. Assoc., Section G.).

Rotatory Converters (*Jour. Inst. Elec. Engin.*).

1899

Presidential Address to the Institution of Electrical Engineers.
(*Jour. Inst. Elec. Engin.*).

1900

Intorno alle Immagini Magnetiche (*Atti dell' Assoc. Elettrotecnica Italiana*).

Ueber Magnetische Bilder (*Physikalische Zeitschrift*).

Report on Electromagnetic Mechanisms (*Rapports et Procès verbaux, Elec. Congress, Paris*).

On Obliquely-crossed Cylindrical Lenses (*Phil. Mag.*).

1901

Faraday und die Englische Schule der Elektriker (Vortrag in dem Urania Theater, Berlin).

Presidential Address before the Physical Society of London.

Some Experiments on the Zonal Aberration of Lenses (*Archives Néerlandaises des Sciences exactes et naturelles*).

1902

Opto-technics (*Jour. Soc. of Arts*).

Second Presidential Address to the Physical Society of London.

Illustrative Teaching. Presidential Address to Friends' Guild of Teachers.

Professor Alfred Marie Cornu (*Obit. Notice, Proc. Roy. Soc.*).

Magnetism in Growth. The eighth Boyle Lecture (Oxford Univ. Jun. Science Club).

Magnetism in Transitu. Discourse (Royal Institution).

1903

The Optical and Physical Properties of Mica (Optical Soc.).

Zonal Aberration and its Consequences (*Brit. Jour. Photographic Almanac*).

The Fourth Traill Taylor Memorial Lecture.

The Dynamo-Electric Machine. Wilde v. Thompson (*Electrician*).

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1904

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